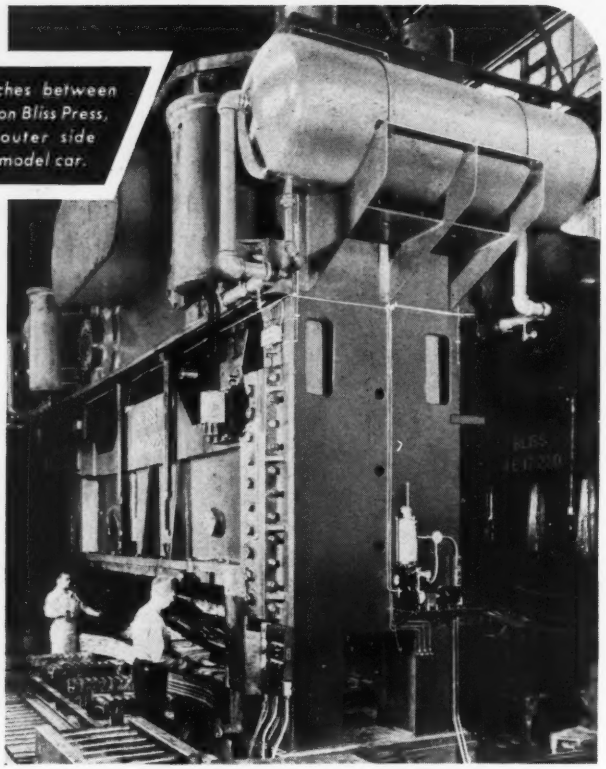
Lubrication ENGINEERING

JOURNAL OF THE AMERICAN SOCIETY OF LUBRICATION ENGINEERS



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Lubrication ENGINEERING

VOL. 5 FEBRUARY, 1949 NO. 1

In This Issue

The Editor's Page . . . 9

Planning a Steel Mill Lubrication Program—W. M. Schuck . . . 10

Functional Tests for Lubricants and Their Interpretation—T. G. Roehner and E. S. Carmichael . . . 15

The Significance of Lubricating Oil Tests—C. E. Hulme . . . 19

The Mechanism of Friction and Lubrication—J. J. Bikerman's reply to comments in October, 1948 issue . . . 27

Current Literature . . . 28

Patent Abstracts, Oils and Lubricants . . . 31

New Products and Equipment . . . 33

Book Reviews . . . 35

News of the Sections . . . 36

Section Officers and Committees . . . 37

A.S.L.E. Personals . . . 38

Advertisers' Index . . . 48

LUBRICATION ENGINEERING
Official Publication of the American Society of Lubrication Engineers
343 SOUTH DEARBORN ST., CHICAGO 4, ILL.

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Northwestern Technological Institute, Evanston, Ill.

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Subscription price, $4.00 per year. Single copies, 75c each, postpaid. Published bi-monthly.

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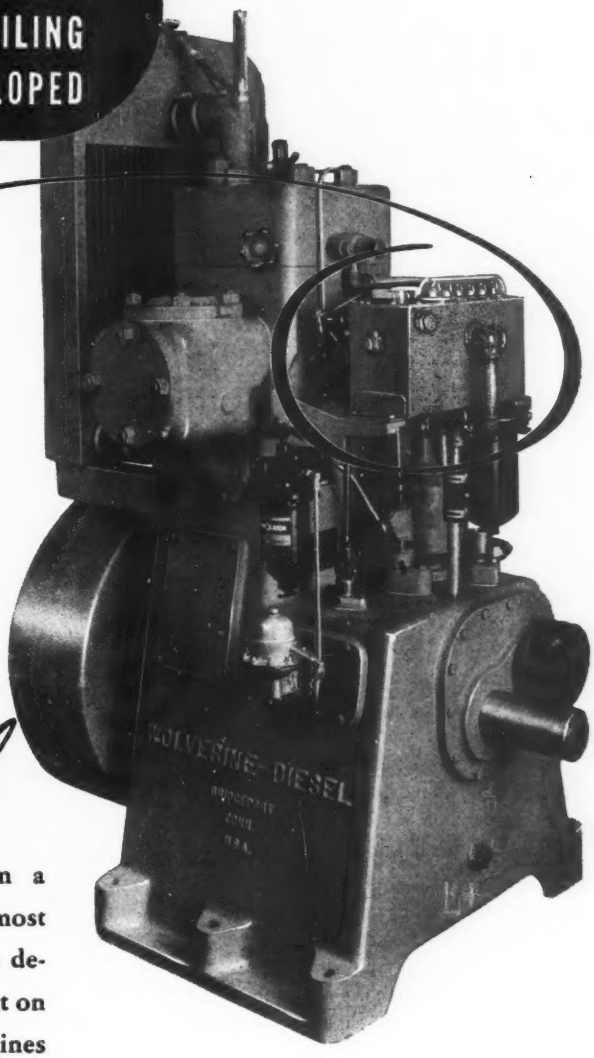

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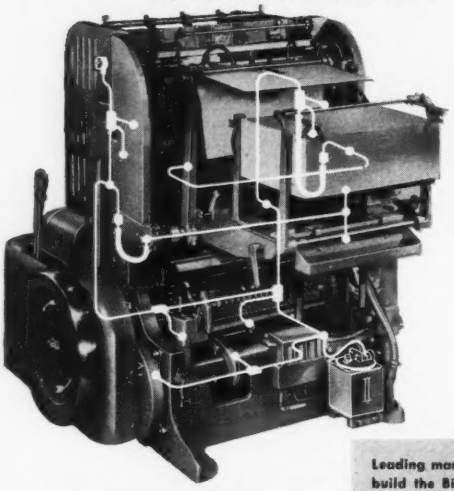

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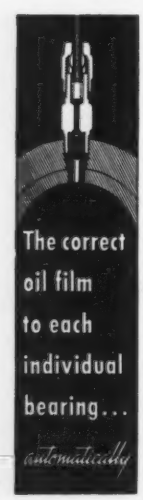

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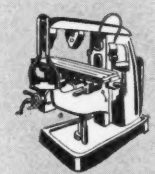

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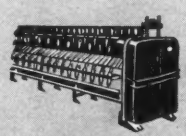

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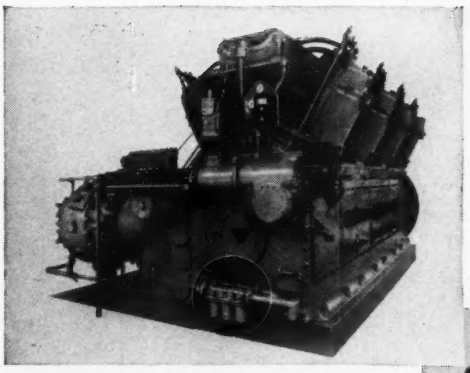

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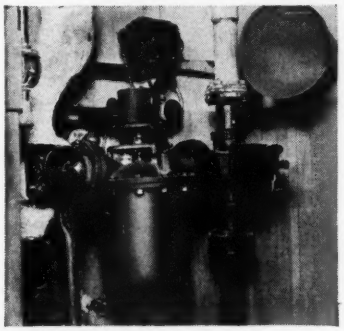

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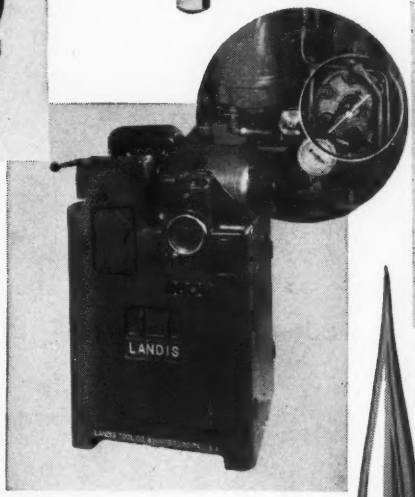

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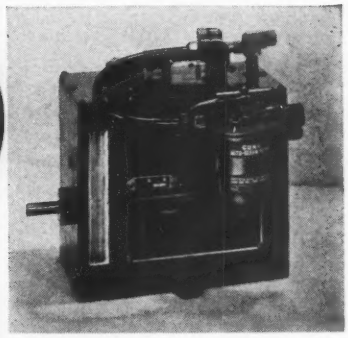

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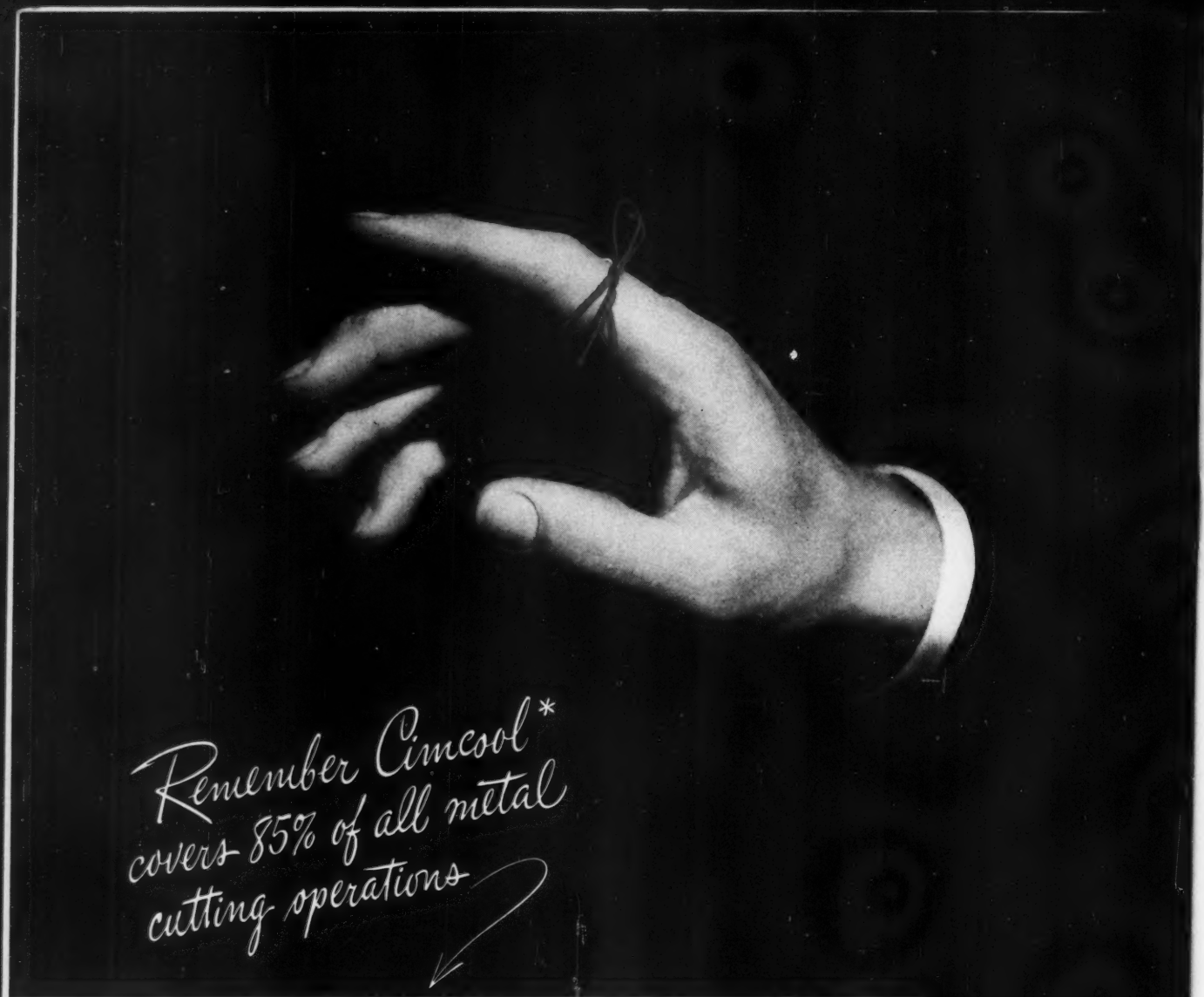

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THE EDITOR'S PAGE

EDITORIAL

A.S.L.E. Fourth National Meeting

AS THE February issue of LUBRICATION ENGINEERING goes to press, it seems fitting for your editor to call attention to the Fourth-Annual Convention of the Society. Plans for this are now rounding into final form, with the meeting starting April 11th and continuing through the 13th. This year the convention will be held in New York at the Hotel Statler. (The Statler is better known to most of us under its former name of the Hotel Pennsylvania.)

Space does not permit detailing the complete program, but among the speakers listed are Dr. William M. Barr, Research and Standards Consultant of the Union Pacific Railroad, who will speak on "Railway Rolling-Stock Lubrication;" Mr. G. M. Reed, Chief Engineer of E. I. DuPont DeNemours and Company, who will speak on "What Lubrication Means to Management," and more than a dozen other speakers who will present papers on a variety of topics during the three-day session. As usual, the meeting will be highlighted by the social evening and by the banquet.

Adding to the interest of the Convention will be a greatly expanded lubrication exhibit. This will be located in the Statler Hotel on the same floor as that, on which the meetings are held. This location will make both the exhibits and session convenient to each other. With the greater space available this year, most of the key manufacturers of lubricants, cutting fluids, handling and conveying equipment will be on hand with product display and demonstrations.

Unified Screw Thread Standards

Unified Screw Thread Standards—November 18, 1948, witnessed the culmination of many years of discussion and deliberation when representatives of Great Britain, Canada and the United States signed an agreement on threads. For the first time, complete interchangeability will be possible between nuts, bolts and other screw threads made from now on in any of these countries. The basic 60 degree thread angle, used in the United States since 1864, has been adopted. For the British, this is a major departure from the 55 degree Whitworth Thread used in England since 1845.

Formerly, one of the annoying aspects of international trade has been the requirement of furnishing excessive screw thread replacements with the equipment sold by one nation to another. Where these could not be available in quantity, often sales were psychologically hindered and countries tended to purchase their equipment almost exclusively from certain manufacturing channels. These thread problems should now vanish completely, as the unified standards take their place in manufactured parts. Freer trade will become possible which may, in some cases, act to the benefit of one or the other of the English speaking countries; but, in any event, the purchaser will profit.

In the new standard, crests and roots will be rounded instead of truncated as was true in past United States Standards, although as it happened worn tools practically made most threads rounded.

Three classes of screw thread fits are now recognized: 1A, 2A, and 3A for external threads; and 1B, 2B, and 3B for internal threads. The *one* classification is for loose work, such as might apply for rough assembly, perhaps with dirty threads; the *two* classification represents the normal production fit; while the *three* classification is a close fit where accuracy and tightness is required.

Exact tolerances are given in the Standard. A few threads will be used in this country which have not been adopted in the International Standard. These are largely in the small size SAE extra-fine series, but with these few minor exceptions complete interchangeability should result in the manufactured products of the three countries.

At first glance the full implications of this Standard may not appear, but its far reaching importance throughout the rest of the world cannot be underestimated. It represents another step in the path of forward progress among the English speaking countries of the world.

B. H. JENNINGS

Planning a Steel Mill Lubrication Program*

By W. M. SCHUCK
Chief Lubrication Engineer, Armco Steel Corp.

I ASSUME that many of you are acquainted with the complexities and problems that the steel mill industry affords the planner of a complete, adequate lubrication program. It is, also, safe to assume, I am sure, that those of you connected with the various lubricant suppliers are well aware of the widely diversified lubrication problems that the making and processing of steel presents. However, for those of you not directly or indirectly connected with the steel industry, I would like briefly to review the problems when viewed from a lubrication standpoint.

The particular operations of my company are concerned with the production of specialty sheet steels of all types in the main. Briefly, these steel products include the usual hot roll and cold roll grades, stainless steels, electrical steels, coated products such as Galvanized, Terne Coat and Aluminized sheets as well as ingot iron and enameling stock. This wide diversification of specialty sheet products results in many different types and kinds of processing machinery that naturally increase the complexity of planned, complete, adequate lubrication.

This picture is complicated still further by the fact that within our mills these products are processed both in sheet and coil form. From our blast furnaces to our shipping departments no two applications are alike. Our problems are many and varied but each steel plant, by the same token, has as many and as varied conditions so, with your permission, I will refer only to steel plants as a general class of manufacturing whose lubrication varies in particular application but not in degree.

Since the beginning of World War II the art of lubrication and those factors attendant to the best utilization of this art have received steadily increased attention throughout all classes of industry. Higher and higher production quotas have forced far sighted management to seek better, longer, operating periods and trouble free service from their plants through intelligent planned lubrication programs. This change in policy has been gradual, and in some instances, slow in being accepted by industry generally. Within the space of a very few years, however, all manufacturing concerns will be cognizant of the cost savings available from this type of program.

The management of my company recognized this problem some years prior to the war and a Lubrication Advisor was selected and placed in one division of the company. His work and training laid the foundation for a much expanded and more comprehensive program that was inaugurated early in 1947. Under this larger and more comprehensive plan a Lubrication Advisor was appointed in each of the company divisions. Detailed plans and policies were agreed upon and a program of training designed to stimulate interest in the theories and practices of lubrication as it pertained to steel mill needs was begun.

So that you can fully understand the scope of the problem as it appeared at the inception of this program, gentlemen, let me discuss briefly the conditions with which any steel plant is confronted at the inception of such a policy. Steel mills generally are not constructed and placed in operation at one time as a unit. Mills are usually the result of long years of expansion and this expansion is caused by larger market demands for products as well as the need to remain on a competitive production cost basis with our similar steel producers. The mills, furnaces, processing equipment are, in some instances, very modern and up-to-date while other sections of the mills may have been in operation for many years. This condition when examined from a basic lubrication standpoint has a definite bearing on the lubrication practices of the mill personnel concerned.

The older more outdated equipment was, and must still be, lubricated by methods and lubricants as they were understood at the time of erection. Waste packed journals on table rolls, sleeve bearings lubricated by waste oil application methods, hand application to open brass roll neck bearing were modern and correct lubrication methods a score or more years ago. Newer equipment has the oil cellar sleeve bearing with its ring oiler, the pressure grease fitting is found on other applications and so on to the modern centralized completely controlled automatic oil and grease systems found on the most recent types of steel mill machinery. This advance in lubrication methods and practices is excellent but one fault becomes immediately apparent to those concerned with an intensified lubrication program in any steel plant. The older experienced personnel in the mills received their lubrication training and ideas on the older and now semi-outmoded equipment. This older personnel in turn trained the newer employees as they joined the steel mill organization, but this training did not advance with the newer and more modern lubrication practices as they appeared in the form of new equipment in the plants.

A very apparent fallacy in steel mill lubrication practices appears at once, the art of lubrication as it is practiced in any plant has for its background the knowledge and training of a period twenty years ago. Again, basically considering the lubrication picture of the steel mills, a second major fault appears. This slow but steady expansion to the new modern mills has increased the number, type and grade of lubricants required to a tremendous degree. The old "600W," black oil, and axle grease that was adequate on the original equipment does not perform adequately on the newer installations with the result that each new piece of equipment as it is installed must be treated as an individual lubrication problem. More and more lubricants were added to storeroom supplies until it is not exceptional to find a steel plant requiring 80 to 100 grease and oil products in its normal operations.

The last very apparent problem is one of lubrication control. Again the older machines require frequent almost continued lubrication while the newer more modern bearings and gearing need rather infrequent lubrication service. Because of the gradual change in this

* Presented before Cleveland-Youngstown Section of A.S.L.E. Nov. 23, 1948, at Youngstown.

requirement, however, the need to definitely control these lubrication intervals was not universally recognized. As a result this very important factor of lubrication control was handled almost by rule of thumb or the availability of personnel and time from other duties and tasks. This generally is the lubrication problem as it is first recognized by those concerned with any newly inaugurated, expanded lubrication program.

In the analysis of any problem it is wise to define the scope and the results desired in the solving of the condition and with these facts defined then to formulate a policy or program that will produce those results. This type of query resolves into why? — who? — and how? Why do we lubricate? Who performs the lubrication and how is the mechanical function of lubricant application accomplished?

The first query, why do we lubricate, is not as simple as first thought would indicate. Lubrication is a means employed to diminish the replacement intervals for machinery parts and excessive replacement of equipment parts or excessive use of lubricants with its attendant labor cost can become an economic liability. Viewed in its most perfect form lubrication is a preventive maintenance tool of the greatest importance but this preventive maintenance too must be used correctly. The correct lubricant at correct intervals and applied in the correct manner is an essential and mandatory phase of any steel mill lubrication program.

The second query, who performs the lubrication duties must also be considered in our basic analysis of the problem. Operators, crane men and maintenance men are not good lubricators unless they are adequately trained in correct lubrication practices. When these groups are charged with lubricating duties two difficulties immediately present themselves. First, a large number of individuals are concerned. For example, in a normal sized steel mill there would be approximately 100 overhead cranes of various types and sizes. Generally, these cranes operate six days per week and require an operator on each turn. As a result, if cranemen were charged with crane lubrication we would have 300 cranemen concerned with the lubrication of these units alone. Now if you expand this condition to include all the operators and maintenance personnel who can be charged with lubricating responsibilities, it becomes apparent, at once, that adequate training is almost an impossibility for such a large group.

The second side of the query, who performs lubrication, is also very apparent, I think when you consider the large group of personnel involved and that is control. It is not feasible to control, by any schedule means, the lubrication of steel mill equipment if almost half of the plant personnel, at one time or another, carries an oil can and a grease gun. Continuing this analysis of the lubrication problem the query of how the lubricant application is performed, also, presents difficulties that must be solved. When, as mentioned earlier, the type of application varies from the old style waste type bearings to the most advanced centralized greasing systems, it is, again, very apparent that training is a vital necessity and standardization is a feature to be desired. And as a final phase the problem of adequate supervision control of this entire lubrication picture must be considered. In the final analysis supervision is responsible for the maintenance, operation and lubrication of the entire mill and should, therefore, have some difinite check and control over lubrication to insure its correct, adequate and complete protection to the plant equipment.

With the problem as a whole and its various phases and ramifications now understand it becomes a problem of how to secure the desired results. Generally it will be considered necessary to appoint a chief lubrication engineer to head the program and to act as coordinator of the program between the various steel plants of the company concerned. The chief lubrication engineer should be a member of the general operating staff and report either directly or indirectly to the General Manager or Vice President in Charge of Operations.

It should be borne in mind throughout the planning and appointing of this key lubrication personnel that the program in its entirety is a maintenance problem and should be either under direct maintenance control or closely tied in with maintenance personnel. In each of the various plants of the company it is necessary, also, to appoint one man who will spend all or the majority of his time and effort on lubricating problems. This man should be directly responsible to the plant maintenance supervisor or to the plant engineer if the functions of engineering and maintenance are combined under one head. All plant problems should be referred to this plant lubrication engineer and when additional aid is required the services of the chief Lubrication Engineer can be made available. This group will comprise the original force by whose efforts the lubrication program is to expand and become operating at whatever size experience dictates. Initially, this small group should be already trained lubrication engineers or given an intensive training course in the rudiments of lubricants, their behavior, standard tests and application methods. This course should impart a working knowledge of lubrication so that preliminary work in the divisions can begin immediately.

It can be definitely stated that even this small beginning will produce results far in excess of the initial expectations. A high degree of interest should be aroused by this beginning throughout all the plants and training for other personnel concerned with lubrication problems should be inaugurated. At this stage in the planning, it should be considered necessary to formulate a general lubrication policy that will act as a guide in directing and furthering the lubrication activities of the various plants of the company. Briefly, the policy should consist of the following points or goals, listed in sequence of their urgency, that will comprise the initial aims of this small lubrication group:—

Lubrication Policy

1. *Training*

   This is the most important phase of the program and upon its success depends the entire future of the policy as such. Complete, correct lubrication training is essential before any control of the use of lubricants, application to equipment, or preventive maintenance through lubrication can be even attempted.

   a. Lubrication classes, designed to effect such training, should be held periodically. It is thought that two general classes each year will be sufficient for the training of new personnel and for "refresher" training.

   b. All newly employed maintenance personnel, apprentices, and present maintenance personnel of all classifications to and including the "oilers" should be given lubrication training as quickly as conditions and adequate groups are available. New supervision within the operating divisions should, also, be extended an invitation to avail themselves to this training.

c. Men closely connected with lubrication, such as inspectors and oilers, should be included in subsequent classes for refresher work and as aids to the instructor in training new personnel within the class.

2. *Plant Lubrication Survey*
A complete survey within the various plants should be made describing the type of equipment, method of application, and grade and name of the lubricant presently employed.
   a. The survey should be complete in its coverage of all the equipment within the plant, and as new equipment is added or changes in present equipment, changes in method of application, or changes in the lubricant itself are made, the survey should be so modified.
   b. Products found by the survey and investigation to be duplicates of other lubricants employed in the division should be eliminated.
   c. General application such as ring-oiled motor bearings or waste-packed type crane bearings, should be standardized throughout the plant in regard to the lubricant employed as well as the method of application and frequency of service.
   d. Simplification of the number and grade of lubricants used within the plant should aid in the actual application, encourage volume purchasing, and conserve valuable storeroom and maintenance space.

3. *Periodic Testing of Major Closed Circulating Oil Systems*
As a preventive maintenance tool, this phase is the most important one of all. An actual knowledge of the condition of the medium protecting "key" units of equipment will forestall major and costly repairs.
   a. Testing should be on a monthly basis and the results so tabulated as to give a complete analysis at all times of the lubricant concerned.
   b. Complete reporting of test results should be made at stated periods to all concerned so that intelligent repair programs and adequate preventive maintenance measures can be planned.

4. *Consumption Control Report*
This report should include the quantity of each type and grade of lubricant used within the plant. It should be divided by departments and compiled on a monthly basis.
   a. This report will act as a control on the consumption within any specified department. Any major variance in consumption should be investigated as a possible indication of equipment damage or equipment change.
   b. A more correct apportioning among the various lubricant suppliers can be accomplished by this means.
   c. These data will afford comparison material when testing new products.

5. *Simplification within Division Departments.*
The elimination of excess grades and types of lubricants should be accomplished within a department of the plant as well as within the plant as a whole.
   a. Overgrading on some applications can be very economical where a department can eliminate one or a number of lubricants by so doing.
   b. Relatively few departmental lubricants directly ease the oiler's application problems and in turn aid the lubrication of the equipment concerned.

6. *Testing of New Products*
This phase should not be attempted to any large degree until all above-mentioned phases are operating satisfactorily.
   a. The allocation of all testing should be made by the chief lubrication Engineer. This will eliminate duplicate testing by the various plants and allow a centralized agency to place the testing procedures where the most severe conditions are to be found.
   b. Tested products should be given company-wide approval or disapproval by the chief Lubrication Engineer before the plants standardize on the use of such products.

7. *Engineering Investigation of New Equipment*
The Lubrication Engineer within each plant should be consulted and coordinated with before the planning or purchasing of any piece of new equipment.
   a. Centralized lubrication systems on new equipment should conform in make and type with the plant policy on such equipment.
   b. Wherever possible, bearings, gearings, and cylinders of all new equipment should be designed to fit present plant lubricants and plant methods of application.
   c. Present plant lubrication practice as it affects new equipment should be approved by the equipment manufacturer prior to the actual purchase.

8. *Lubrication Practices*
The methods of lubricant application, the time intervals between applications and the personnel entrusted with lubricating tasks should be standardized as far as practical and consistent with good lubrication theories.
   a. Overlubrication is considered to be a fault that stems from poor control of lubrication time intervals and a definite company-wide policy on general types of applications must be developed.
   b. Bookkeeping or paper control of all lubrication is considered a necessity if the steel mill is to be assured of correct lubricant applications. The type of control finally adopted should be insofar as possible, standard throughout all plants.
   c. Where possible the number of personnel entrusted with lubrication tasks should be held to an absolute minimum. Eventual lubrication of the entire plant by a small group entirely divorced from other duties is a goal to be achieved as the best possible method of control.

9. *Codification of Lubricants*
A standard company-wide system for coding lubricants in use throughout the divisions should be considered and formulated. Control and application by a code system will eliminate, to a great degree, the often misguided preferences for definite brand name products presently in effect.
   a. Coding will allow more complete standardization of lubricants within the plants. It will, also, simplify to a large extend the ordering of lubricants from plant stores.
   b. A coding system will allow field tests to be conducted on a more impersonal basis by eliminating any personal prejudice that brand names might engender.

The above policy as it has been outlined can become the frame work, upon which it is possible to hang a going, active lubrication program. It is obvious that such a policy and program is continuous and that a great deal of work must be accomplished before the policy can be considered an operating success. It is impossible to change the thinking, procedures and the attitude of a large group of people to the extent out-

lined above in a short period of time. It might be of interest at this point to review the major items of this lubrication policy and detail the suggested methods to be used in achieving these aims.

Training should justly receive the greatest attention. Classes must be held in every plant and as large a group of interested personnel as possible supplied with very pertinent practical lubrication information. This group should be composed of maintenance foreman, maintenance inspectors, repairmen and apprentices. In all instances I am sure you will find the reaction extremely favorable and enthusiastic. The training recommended should be a combination of text book work and lectures on the physical testing and evaluation of lubricants, theories of full film and boundary lubrication, the action of mechanical lubrication devices, theory and uses of extreme pressure lubricants, practical maintenance of major closed oil circulating systems, operation of centralized grease systems and general lubrication standard practices. This text and class work should be interspersed with discussions of problems pertaining to the plant concerned, with examples of good and poor lubrication practices as observed within the same plant and suggestions for the improvement of plant lubricating conditions.

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A course of this calibre will require approximately forty hours of classroom time and a practice in this regard that our company has found to be very practical has been to hold a morning four-hour session only and have the course run for two weeks' duration. Each member of the class should be given the text material for his permanent use as well as a series of normal lubricating questions and their answers for his future reference. As has been stated the reaction to this type of training is sure to be very gratifying and the results will more than offset the cost of such a policy in interest, better lubrication and trouble-free equipment operation.

Complete and factual lubrication surveys must be made in all plants. It is obvious that without such surveys any attempt at lubricant standardization will be futile. These surveys should be quite detailed in their coverage and the actual lubricating practice recorded in each instance. It is recommended that no attempt be made to correct lubricating conditions during the survey. After the surveys are completed and compiled in usable form, a study of the entire situation can be made insofar as lubricants alone are concerned. Incorrect applications, duplicate products and extremely small consumption products can then be noted and listed. A new survey should then be compiled showing the presently used product and, where necessary, a recommended substitute material. In attempting this consolidation or standardization of each plant's lubricant requirements a definite effort must be made to insure each supplier of essentially the same percentage of lubricant business under the new plan that has been enjoyed in the past. Completion of this phase of the lubrication programs in the plants should decrease the number of products purchased, however, until "on hand" stocks are completely exhausted this gain in simplicity will not be apparent. A definite gain should be observed, however, from this phase of the program in lightening the lubricators' task of application and in greater bulk buying with the elimination of small 25-, 50-, and 100-pound package purchases.

The program of Periodic Testing as applied to key closed circulating oil systems should be inaugurated as soon as the plants have purchased the required laboratory equipment. All plants should immediately inaugurate this control feature so as to enjoy the benefits of this preventative maintenance tool. Depending upon the lubricant concerned, this periodic testing involves a viscosity test, a precipitation test and a neutral number check. By a monthly examination of the lubricant in use through these tests, it is a relatively simple matter to safeguard the equipment protected by that lubricant from any harmful change in its properties. Simple visual inspection of the gear case lubricant of a main mill drive, for example, is practically worthless as a control measure. Experience has definitely proven that lubricants that appear visually to be in excellent condition were in reality not capable of performing the function of protection at all. Usually this condition is very apparent where one system of relatively light viscosity oil is in service on the bearings of a gear reduction drive and another heavier lubricant is employed to protect the gearing itself. Cross leakage between the two systems often occurs without any apparent change in the volume of lubricant in either system. However, the viscosity change after cross leakage of this type can be sufficient to cause either bearing trouble or excessive gear wear. The results of these monthly tests must be given wide distribution in the maintenance department and a running graph record of the test findings should be kept for background and experience purposes. This testing phase is certain to produce valuable dividends for any plant as the lubrication program becomes operative and experience has made the findings of value.

The monthly lubricant consumption report for each plant can produce immediate results of a very beneficial nature. As mentioned above, this report should simply list the quantity of oil and grease used during the last monthly period by the various mill departments. And this departmental total volume can be further subdivided to show the amounts by brand name and grade that go to make up the total consumption figure. Naturally, such a report will do nothing toward actually controlling the volume of lubricants used but the psychological effect of seeing the amounts listed and tabulated in this manner tend to make supervision very conscious of that consumption. Usually, the large consumption items in each department will decrease appreciably immediately after this report is inaugurated. These data have the additional advantage of supplying the chief lubrication Engineer with consumption figures, with

which it is relatively easy to adjust any inequalities in purchase volume among the various lubricant suppliers. Naturally, any large consumption increase of a particular product within a department should be scrutinized very carefully to determine the cause.

The simplification or elimination of duplicate type lubricants within departments will progress almost automatically with the other phases of this type of program. In some instances it will prove economically feasible to "overgrade" a grease or oil on some equipment to eliminate the need of an additional brand. It must be noted that such simplification should be carefully controlled. Indiscriminate "overgrading" can prove to be a very costly form of improvement. However, judicious use of this feature can produce distinct labor savings and trouble free service by simplifying the "oiler" application tasks to a minimum.

The testing of new lubricants and checking of presently used products is a phase of this new lubrication program that should not receive a great deal of early emphasis. It is the speaker's belief that a great amount of good can be derived from laboratory and field testing if they are properly handled and controlled. Testing based upon "field" or mill trials, however, is not considered to be adequate. There are too many imponderables placed in any field test to allow the results to be conclusive. On the other hand, a great deal of argument pro and con has been raised in regard to the so-called "bench" or laboratory testing. In the final analysis neither method is sufficient in itself but the combination of the two should pay ample dividends. The point should be stressed here, however, that where the application of a lubricant to a particular piece of equipment is correct, it is perfectly safe to rely upon the product suggested by any of the reputable lubricant suppliers. Testing is a refinement phase of any lubrication program not a basic necessity to the success of that program.

Coordination between the Engineering Department and those concerned with lubrication control is a vital need. When initial design is correct from a lubricant standpoint little, if any, trouble will be experienced in servicing that equipment with the proper lubricant.

It should be constantly emphasized and reemphasized in all dealings with equipment design personnel that the lubricant is as much a part of the equipment under discussion as a bearing, a shaft or a roll of that equipment. Just as the wood, glass, steel or bronze that is incorporated in the design of a new piece of machinery has definite physical limitations so has the lubricant that will be used to control wear on the equipment in question. Oil or grease cannot be called upon to supply protection beyond its powers any more than an undersized shaft or bearing can be relied upon to give perfect operation. In the initial design stage it is also important to incorporate grease fittings, centralized grease systems, closed oil systems and lubricant applicators that conform with division or departmental standards. Too often the unfortunate experience has been to find new equipment being installed with grease fittings that are foreign to the department, in which the equipment is to operate. Lastly, in this regard, it is often advisable to consider the frequency of application that new equipment will require. A small change in preliminary design may effect large labor savings in the use of the oiler's time after the machine has been placed in production.

Lubrication practices have been given a fairly low priority in this planned policy or program of lubrication. Lubrication practices or who lubricates what machine how often by whose orders is a very important phase of any planned program, but its importance and its place on the list of phases has been purposely toned down. It is obvious that at the outset of any lubrication policy some method of lubrication and some schedule of practices are presently in effect. These methods and schedules may be completely in error when viewed through a lubrication engineer's eye but the fact remains the plant in question *has* been operating under those conditions and the plant equipment has *been able* to function and produce. When the problem is approached with this attitude the reason for correcting lubrication practices in the latter phases of this proposed program becomes apparent. During the preliminary investigation of any lubrication practices, it will usually become very evident that two answers are required. First, a definite control will have to be exercised by supervision over all lubrication occurrences before any constructive changes can be made. Let me amplify that statement, by a hypothetical example. In Department A there are located some 250 motors of which approximately 30% are of the ring oiled sleeve bearing type while the remaining 70% are anti-friction bearing motors. It is found to be the practice, evolved through the years, in Department A to relubricate the ring oiled motors once per week and resupply with grease the anti-friction bearing motors once per month. You will agree that both occurrences figures are possibly too frequent but the most important concern is the fact that the maintenance foreman in Department A schedules these lubrication cycles from memory. It was found that no running schedule was kept noting the date of the last lubrication application or the next future date at which an application would be required. Neither was any schedule attempt made to insure the complete coverage of all of these motors. One or two motors located in isolated positions could very easily have been overlooked without supervision being at all aware of the fact. Further there was no assurance found that the apparent lubrication cycle of once per week and once per month was an actuality. Assuming that motor No. 28 was a ring oiled type did the oiler on his last lubrication trip actually add oil to those bearings or did he inspect them and find an ample oil supply still in the bearing wells?

Definitely a fool proof continuous schedule check of lubricating practices is required before any solution to this problem could be found. Generally, most lubrication occurrences will tend decidedly toward overlubrication rather than under lubrication. This condition is, of course, the natural result of the hypothetical example just made. Overlubrication presents two problems when it is considered. One, the damage occasioned equipment by over lubrication and two, the labor cost involved in this really non-productive task. The problem of lubrication practices must receive a great deal of consideration in any plant and the final solution to this problem must be conditioned by the plant personnel plan. However, it is safe to state that usually all available data will indicate the adoption of a definite schedule check system and an entirely separate lubricating organization whose sole function would be lubrication as the best solution to this problem when personnel policies permit such a program.

Codification is the final phase of any augmented lubrication program. The coding of lubricants both greases and oils is considered to have some merit from a purchasing, handling and psychological side. However, this phase is purely a refinement feature and little work should be contemplated in this regard during the early phases of the lubrication program.

Functional Tests for Lubricants and Their Interpretation*

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CONVENTIONAL physical and chemical tests are employed in the control of manufacture of lubricants and as a check on uniformity of shipments. The danger in utilizing the results of conventional tests, such as gravity, viscosity, dropping point, etc., for guiding product recommendations, lies not in the limited information furnished by these results but in the possibility of extending the scope of meaning of these data to predict, without reservation, the probable performance characteristics of lubricants under actual service conditions.

The pour point of an oil, for example, is sometimes stipulated to indicate the suitability of a product for refrigeration applications. This test, in itself, cannot be satisfactorily employed for this purpose. Even though the pour point of the product is well below the minimum temperature encountered in a given refrigeration system, the admixing of the oil with certain refrigerants, such as dichlorodifluoromethane (Freon 12), might result in precipitation of waxy constituents above this temperature with the subsequent plugging of expansion valves. Furthermore, even though the oil might be suitable in low temperature properties, deterioration products, resulting from use, might promote "copper plating" or separate from the lubricant to cause operating difficulties.

The ASTM unworked and worked penetrations of a grease at 77 F are frequently used erroneously as a basis for predicting the performance properties of soap thickened products. If data obtained by this test are regarded as indicating anything other than "hardness" values, determined at room temperature before and after working the product under prescribed conditions, serious difficulties may be encountered. The results of penetration tests cannot be projected to indicate the pumpability properties of a grease, torque values at specific rates of shear, or structural properties at low and elevated temperatures, as is sometimes attempted.

Another of the conventional type tests, the significance of the results of which are occasionally extended beyond the scope of the test, is that for determining the ASTM dropping point of a grease. Actually, the result obtained by this procedure cannot, in itself, be used for indicating the characteristics of a product under actual service conditions. In this connection it is to be noted that under ASTM Designation D-566-42, entitled "Standard Method of Test for Dropping Point of Lubricating Grease," it is stated that the dropping point "should not be considered as having any bearing upon service performance." By definition, the dropping point is the temperature at which the first drop of the sample falls from a receptacle or cup while the temperature is raised in accordance with the specified conditions. However, greases having relatively high dropping points may be entirely unsuitable for high temperature applications because of other limiting properties such as resistance to oxidation and evaporation. This fact should be emphasized

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* Paper presented at 3rd Annual Convention of A.S.L.E., Buffalo, N. Y., April 21, 1948.

because at the present time undue stress is often placed on the importance of the results obtained by this procedure.

Numerous other examples could be cited to illustrate the limitations of conventional physical and chemical tests, but the above will suffice. It should be emphasized that if the signficance of such tests is recognized, the results thereof may be usefully employed. It is not the objective of these introductory comments to minimize the importance of conventional tests, but rather to point out that, at best, they can be utilized only as a rough guide in predicting performance properties of products under actual service conditions.

To bridge the gap between the aforementioned type tests and evaluations in the field, functional tests are often used. For the purpose of this short paper, functional tests are defined as tests intended to evaluate lubricants in terms of their performance in specific equipment under conditions which simulate those encountered in the field. The chemical and physical tests referred to above supply data regarding certain limited properties and, to a large measure, these data are the basis for the language used to describe the lubricants. Functional tests go further in that they furnish information regarding the quality of lubrication obtained from products thus described. However, even they are seldom regarded as self-sufficient in that respect. The final word on lubrication is still determined by field tests with the proviso, of course, that those tests are properly conducted. Therein lies the main stimulant for functional tests in the laboratory. It is not an uncommon experience to encounter major difficulties in controlling field tests so that the data are not significantly affected by unknown conditions introduced by sudden changes in production schedules, human equations, etc. Operators of machinery vary widely in respect to their skill and attention to the details necessary to run a test of one product versus another, or to evaluate one set of operating conditions versus another. There has been a trend, therefore, to pay more attention to laboratory functional tests as a means for evaluating lubricants because they enable better control over the variables on which accurate evaluations are dependent.

Numerous papers have appeared in the literature during the past few years in which detailed descriptions of certain functional tests have been presented. As typical examples of these tests, reference might be made to a stick-slip apparatus[1] for evaluating the oiliness characteristics of table way lubricants, an improved anti-friction bearing machine[2] for testing ball bearing greases under conditions of load and a tester[3] for evaluating wheel bearing greases. To illustrate this type of test more specifically, a brief description is given below of a laboratory test assembly which has been found to be useful in the evaluation of hydraulic oils, particularly for machine tools.

The testing of hydraulic media is an important consideration, because in present day practice most industrial machines are actuated through hydraulic controls. Any tendency on the part of the lubricant to precipitate adhesive type deposits, to afford inadequate protection of metallic surfaces against corrosion, or to possess insufficient oiliness or film strength characteristics to prevent wear of moving metallic parts may cause not only mechanical difficulties but also serious shutdowns. For this reason, a reliable functional test for evaluating hydraulic oils can be a useful screen for classifying oils for this application.

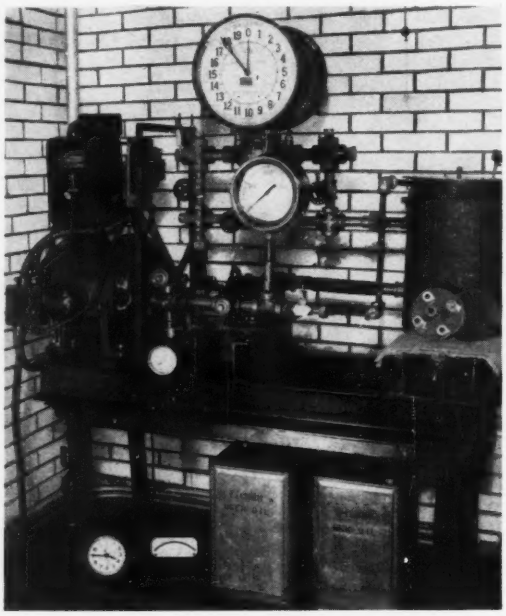

Fig. I. Hydraulic Pump Test Assembly

Test equipment which can be satisfactorily utilized for this purpose is shown in Fig. 1. It will be observed that the unit consists of a vane type pump, directly connected to a 3 HP electric motor. The oil reservoir is mounted on the same table with the motor and pump, and the oil strainer is attached to the oil intake line in the reservoir. Operating pressure is controlled by a relief valve, which is fitted into the pressure line from the pump. The oil at low pressure returns to the reservoir through a flow meter. Operating temperature of the hydraulic fluid is controlled by means of an automatic electrothermo regulator and a water cooling coil.

A close-up view of the pump parts is shown in Fig. 2. These parts consist of a rotor, vanes, ring and two brass plates or bushings, one of which is indicated in the photograph.

The standard procedure for conducting a run involves circulating the oil at a temperature of 175 F under a pump pressure of 1000 psi for a period of 1000 hours. In beginning the test, the machine is completely disassembled and all parts and lines are thoroughly cleaned. A complete set of new pump parts, i.e., rotor, ring, bronze bushings, and weighed vanes, is installed and the system is thoroughly flushed with new heated oil. The unit is given a break-in run which is continued until a steady flow rate of about 1.3 gallons per minute is attained. After draining the break-in charge, 3 gallons of the test oil are then introduced into the system and the test is started. A 2 oz. sample of the oil is removed at 100 hour intervals for conventional physical and chemical tests and the pump is opened for inspection every 250 hours. At completion of the run, the vanes are again weighed to determine metal loss due to wear. The pump parts, and, in fact, the

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[1] LUBRICATION ENGINEERING (June 1946), M. Eugene Merchant.

[2] *General Electric Review* (October 1947), D. F. Wilcock.

[3] *S. A. E. Journal*, Volume 54, Pages 133-137 (March 1946), E. W. Adams.

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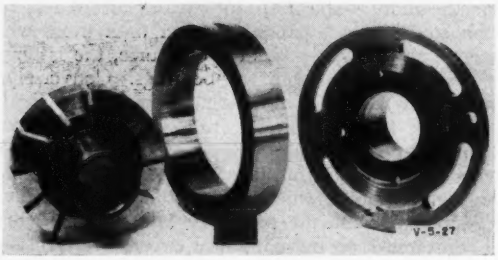

Fig. II. Internal Parts of Hydraulic Pump Showing Rotor, Ring, Vane and Brass Plate.

entire system, are inspected for evidence of corrosion and the presence of deposits. A record is kept of any operating difficulties which might have occurred during the test period.

To illustrate the differences in oils for use in vane type pumps, data obtained during runs on two oils are presented in Table I. It will be observed that in the case of Oil A, only slight changes occurred in the characteristics of the product, based upon the results of conventional physical and chemical tests. When this oil was employed, practically no vane wear occurred and not more than traces of deposits were observed in the system. There were no evidences of corrosion. In the case of Oil B, however, marked changes resulted as evidenced by increases in viscosity and neutralization number. Vane wear was excessive when this product was employed and deposits were present in the pump and reservoir tank.

Figures 3 and 4 show the condition of the filter screen, relief valve piston and spring as removed from the system after Oils A and B were tested. It will be noted that the parts were in excellent condition in the case of Oil A, whereas excessive deposits were present in the case of Oil B. The heavy vane wear which occurred when Oil B was in the system is shown in Fig. 5.

Obviously, the data presented above would indicate that Oil A would be superior to Oil B for use in vane type pumps under the conditions of the test. It is felt that the results give a fairly reliable indication of chemical stability and anti-wear properties. It should be pointed out, however, that this method is an accelerated test in that most of the hydraulic oils in machine tools are circulated at temperatures appreciably lower than 175 F. Furthermore, the test results have limitations because the hydraulic media in systems in actual practice frequently become contaminated with water, grinding and cutting fluids and other materials. It is obvious that this test will nevertheless disclose more data regarding performance characteristics than will a combination of conventional tests.

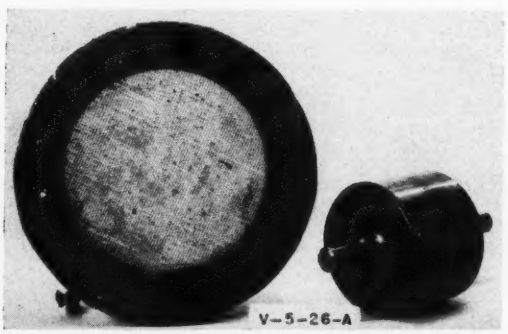

Fig. III. Screen and Relief Valve Plunger After 1,000-Hour Test Run With Oil A at 1,000 PSI, 175 F.

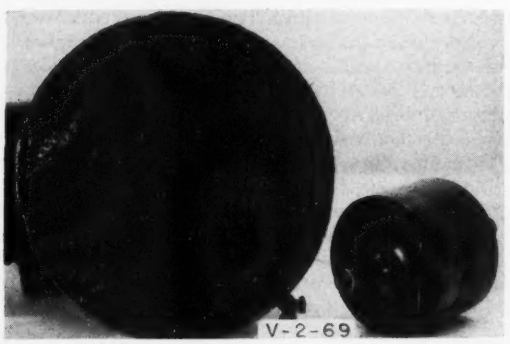

Fig. IV. Screen and Relief Valve Plunger After 1,000-Hour Test Run With Oil B at 1,000 PSI, 175 F.

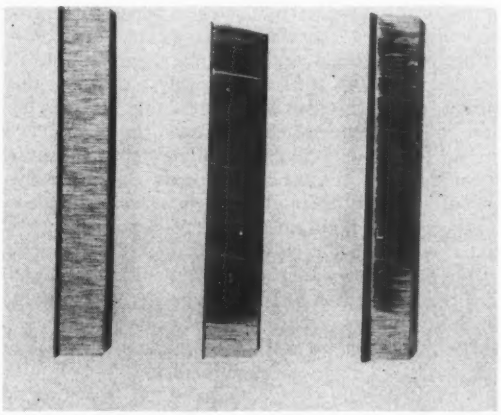

Fig. V. Comparison of Wear on Vanes After 1,000-Hour Test Runs at 1,000 PSI, 175 F.

It is believed that the successful functional test will be based on the following broad considerations:

1. Availability of accurate data regarding conditions encountered in actual service.
2. Extent to which certain field operating conditions can be simulated on a laboratory scale.
3. Instrumentation or equivalent means for expressing the test data in numerical terms, so that the ratings of the products need not rely on adjectives difficult to define.
4. Reproducibility and repeatability, obtainable within significant limits without too much dependency on human equations.
5. Ability to interpret and correlate the data with field experience.

Of the above, 2, 3 and 4 are largely in the hands of the designer of the testers. Therein lies one of the most troublesome aspects of functional testers, i.e., cost of the equipment and its operation. These considerations are subject to pressure from a number of directions and are normally not neglected. Points 1 and 2 warrant more attention than is usually given to them. Instances could be cited where a group of experienced laboratory men complied with points 2, 3 and 4, but their work was of limited value because of inadequate

knowledge relative to 1 and 5. For example, it is sometimes extremely difficult to obtain accurate information regarding the temperatures to which the lubricants will actually be subjected. Temperatures are a key factor. There is evidence to support the statement often made to the effect that each increase of 25 F above room temperature will halve the life of the lubricant. The difference between 200 F and 300 F has a much greater effect than is often realized. Increasing the test temperature 50 F or more just as a factor of safety, or as a means for accelerating the test, may lead to unnecessary complications that will more than counterbalance those objectives.

Many functional testers are designed to evaluate lubricants for anti-friction bearings. Continued use of such bearings above the temperature recommended by their manufacturers will lead to metallurgical troubles that may be difficult, if not impossible, to differentiate from lubricant failures. A similar precaution should be mentioned regarding loading of the bearings.

Under the general heading of knowledge of service conditions there are a number of other possible complications. For example, frequency of application of new lubricant and, particularly in the case of greases, provision for the relief of overpacking. If laboratory tests are run with a single charge and with the bearings properly packed, the comparative ratings of the products may be quite different from those reported by the field because in actual service the operators may insist on frequent applications of new greases and may observe no precautions to prevent overpacking. In such cases, the functional tests to agree with the field conditions should be run with the bearings packed in various ways, including a full pack. Variations in housing design are another example. If the tests are run with fully sealed bearings, whereas in the field the same lubricants may be employed also in bearings provided with part or no seals, the failure to anticipate the latter condition may lead to difficulties. As still another example, if the bearings oscillate but the functional tester provides only for the conventional complete rotational movement, there may be disappointing correlation with field experience.

Some of the comments made above also apply to point 5, interpretation of the practical significance of the laboratory test data. The desire to minimize the difficulties inherent in the translation of results from functional tests has been one of the major reasons for the adoption of rather complicated, expensive testers. There is a growing preference for equipment that provides for loading of the bearings to the same degree encountered in service, even when the main objective is to obtain information on oxidation resistance under dynamic test conditions. There is even a reluctance to accept figures on resistance to leakage unless the bearings are operated under load.

As in the case of physical and chemical evaluations, care must be exercised in interpreting the data of functional type tests, in order that a product is not adopted for use under conditions where it is not suited or is withheld from service under conditions where it would be satisfactory. In this connection, it is to be noted that certain type data, such as those obtained in water resistance tests on greases, are frequently misleading when they are extended to predict other properties of the lubricant. Because a grease is water resistant, for example, is no reason for considering it as being satisfactory with regard to rust preventive characteristics. In fact, field testing[4] has shown that in the presence of water the more water resistant greases afford less protection to bearings against corrosion than those which are water dispersible, provided, of course, the latter are not washed entirely from the bearings. Conversely, if a product is shown by functional tests, such as in low h.p. motors, to be unsuitable for a given low temperature application, it should not be construed that the same lubricant would not be satisfactory in the bearings of higher h.p. motors where greater torques are involved.

There is one factor regarding which there will be little difference of opinion, i.e., experience. It is an axiom that until the test data are interpreted they are just so many figures. Even complete data benefit from interpretation by experienced operators and incomplete data can sometimes be thus converted to valuable information.

The standardization of the conventional tests such as gravity, flash, viscosity, etc., has greatly facilitated the exchange of information regarding the chemical and physical properties of lubricants. Standardization of functional tests presents many difficult problems, but encouraging progress is being made in that direction and should likewise promote a better understanding of the performance characteristics of lubricants among lubrication engineers.

TABLE I

HYDRAULIC PUMP TEST RESULTS
1000 Hour Run @ 175 F and 1000 psi Pressure

	OIL A 160 Sec. Oil having Good Chemical Stability and Anti-Wear Properties		OIL B 160 Sec. Low-Quality Oil	
	Before Test	After Test	Before Test	After Test
Hours	0	1000	0	1000
Gravity, API	33.4	33.1	33.5	30.1
Flash, F	410	410	410	400
Saybolt Viscosity @ 100 F in Sec.	160	161	161	252
Color, ASTM	Dark 2	Dark 3½	Light 2	Brown
Neutralization No.	0.05	0.1	0.05	8.3
Vane Wear, %	—	Less Than 0.1	—	5.7
Deposits in Pump and System	—	None	—	Heavy

Discussion of Paper by T. G. Roehner and E. S. Carmichael on "FUNCTIONAL TESTS FOR LUBRICANTS AND THEIR INTERPRETATION"

W. R. MOORE

Materials & Process Section, Motor Engineering Department, Westinghouse Electric Corporation, Buffalo, N. Y.

Any comments on the papers which have been given this afternoon should be prefaced by a word of praise as to their quality. They show careful attention as to preparation and are an excellent summary of general and specific test methods. All the authors have taken pains to point out that any attempt to evaluate lubricants must, in the final analysis, be judged on the basis of actual operating performance.

Obviously, this latter method of evaluation is practically impossible because of the variety of conditions under which a particular product may be used, lack of personnel to follow the work and to evaluate the data, and lack of time to get the answer. Short term test data are therefore necessary and desirable even though lacking in direct applicability.

(*Continued on page* 47)

[4] *Coordinating Research Council Publication* CLLG-37-44 (1944).

The Significance of Lubricating Oil Tests*

By C. E. HULME
Kendall Refg. Co., Bradford, Pa.

IT IS the purpose of this paper to discuss briefly the significance of some lubricating oil tests in the hope that some lubrication people present may be able to find some useful thought in it. The speaker is well aware of published thinking to the effect that by and large, lubricating oil tests have little useful significance and that buying or recommending lubricants through specifications which place maximum and/or minimum values on physical and chemical properties is anything but a reliable method of securing a suitable product. Despite this, he would like to express the opinion that through the intelligent use of test data, much useful information is available to the lubrication engineer.

Before consideration is given to particular test methods and results, it might be well to define for ourselves the word "test." A "test" is here considered to be the result secured by subjecting a lubricant to a standardized method of testing procedure.

The number of tests as applied to such materials is large, the American Society for Testing Materials alone listing approximately 40. Other recognized methods will raise the number considerably.

The following will be an attempt to show that a number of these tests, when understood and properly applied, have a definite useful significance.

Pour Point

The pour point of a lube oil as measured by A.S.T.M. method D-97 is the point of temperature below which the lubricant will not flow. The temperature at which flow ceases, as defined by the method, may be attributed to solidification of wax present or to the viscosity of the lubricant becoming so great that flow cannot be observed.

If the lubricant contains wax and is of a sufficiently light color, a haze or cloud may appear at temperatures considerably above the pour point. This temperature at which wax is coming out of solution is known as the Cloud Point.

Should moisture be present in the oil and although the oil appears clear and bright at atmospheric temperature, it can drop out of solution as the temperature of the oil is decreased and also cause the oil to take on a cloudy appearance. A wax cloud as distinguished from a moisture cloud can be readily recognized by observing that wax clouds start their formation at the bottom of of the test jar used and gradually work up through the body of the oil sample whereas the moisture cloud appears throughout the entire sample within a degree or two of the initial temperature of its appearance.

The pour point can be related to the flow of the lubricant through lines and when in a crankcase, to the flow to the oil pump or if in a gear case, it may relate to the temperature at which moving gears will cut a channel.

Pour points can vary widely depending upon crude oil source and refining methods. Paraffin base lube oils normally possess higher pour points than do napthenic base oils. This is due to the high wax content present in the former. Low pour point oils are available which contain much of the original waxes which they may have contained. This comes about by the addition of small quantities of additive agents known as pour point depressants. In such cases, the cloud point remains high, however.

In a lubrication system, anything which might prevent the lubricant from reaching the point where needed is objectionable. Hence, the pour point may well be related to gravity-feed systems and oils of proper pour point should be selected which will assure their non-solidification. Forced-feed systems are not as dependent upon pour point as gravity systems provided the lubricant can reach the pump.

Where lubrication is accomplished by means of a wick-feed, the presence of wax crystals in the lubricant may plug off the wicking with the result that the system may be starved.

Oils containing appreciable wax, even though they have low pour-points because of addition agents, may be found to revert—that is assume a pour point higher than was shown on the original test. Care should be used in selecting lubricants, particularly for gravity-feed systems where the system is subjected to temperature fluctuations above and below the cloud point as this fluctuation is related to pour reversion.

It behooves the engineer to interpret pour points and cloud points in regard to known actual conditions in use.

Carbon Residue

The carbon-residue test was originally developed for the purpose of forecasting the carbon depositing tendencies of oils in combustion chambers.

The Conradson Carbon Residue test as devised by P. H. Conradson and adopted in 1930 as an A.S.T.M. standard test method will predict the depositing tendency of oils under constant conditions of operation and oil consumption. Bahlke, Barnard, Eisinger and Fitz Simons[1] report the use of the 90 per cent distillation point at 1 mm. pressure as giving better correlation with depositing tendencies. More recently the A.S.T.M. have adopted the Ramsbottom Coke method. All of these methods will be useful to the engineer as a guide in selecting lubricating oil where due consideration has been given to operating conditions.

Air-fuel ratios, fuel character and dust can all influence engine head deposits.

* Paper presented at 3rd Annual Convention of A.S.L.E., Buffalo, N. Y., April 21, 1948.

[1] W. H. Bahlke, D. P. Barnard, J. O. Eisinger and O. Fitz Simons "Factors Controlling Engine Carbon Formation" Journal, S.A.E., Vol. XXIX, Page 219 (1931).

Corrosion Tests

Because lubricants are used in contact with metals their corrosive action toward these metals is, under many conditions, of importance. In some cases, a controlled amount of corrosion is desirable. This is true with certain types of gear lubricants. Generally very little or no corrosion is desired.

A number of corrosion tests are in use. The copper strip test in which a copper strip is submerged in the oil for periods of from 3 to 5 hours at temperatures of 200 to 212 F. is very common and is widely used. This test may indicate the presence of compounds which are corrosive under these conditions but it does not indicate the degree of corrosion.

Because of the presence of acidic materials normally present or created by oxidation of engine lubricants, they are often corrosive to bearing metals. Such tests as the Underwood and Indiana Stirring Oxidation tests are sometimes used to determine their presence.

Sulphur compounds often find use in lubricants as corrosion preventers, however, the presence of a high natural content of sulphur is not desirable.

Neutralization Number

The neutralization number test has been designed to measure the presence of either Acid or Alkali constituents present in lubricants but without regard for their being mineral or organic in nature.

Organic acids naturally occur in petroleum products and their presence is not to be interpreted as poor quality or careless refining. In many instances, lubricants have, during the course of refining, been acid-treated and subsequently alkali-treated. This treatment can account for the presence of either type of materials in the finished product. This is also true for the incorporation of many of the so-called Additive Agents. Many of these products impart either acidity or alkalinity to the lubricant.

It is quite generally agreed that there is no necessary relationship between neutralization number and bearing corrosion. Where operating conditions are constant and a lubricant of constant composition and source has been used sufficiently long to have allowed the writing of its neutralization number history, it has been found that this test is reliable in predicting periods for oil change or equipment inspection.

There has been a practice in use of requiring that the "organic acidity calculated as SO_3" shall not exceed some predetermined value. This practice is meaningless and may lead to confusion by virtue of the implication that either of these constituents may be present.

The procedure is widely used industrially despite the fact that its true significance is not known.

Many industrial people are guided not so much by the absolute values they measure as by the rate of change of the values.

Quick or sudden changes are often used to indicate unusual or undesirable conditions which prompt investigation. Gradual increases are often plotted against time as a measure of oxidation rate which when used with other test data is used to determine lubricant life.

Saponification Number

When a lubricant contains or is suspected of containing fatty acids, the quantitative measurement of these fatty acids can be measured by means of the Saponification Number test. This procedure measures both free and combined acids.

It is used to measure the quantities of fats or fatty oils which have been purposely added to the lubricant as well as to follow the progression of some types of lubricant oxidation.

When used to measure quantities of fats or fatty oils contained in a lubricant, it is necessary to know which fats or fatty oils are being dealt with.

Mr. C. E. Hulme was educated at St. Bonaventure College, Allegany, New York, and became Control Chemist for the Kendall Refining Company, Bradford, Pennsylvania, 1928-1948. He also served as Instructor of Petroleum Refining, 1938-1944, for Pennsylvania State College, School of Mineral Industries, Extension Division. He is now Manager, Field Engineering, Kendall Refining Company, Bradford, Pennsylvania.

Color

The color of lubricants are generally classified as to transmitted or reflected light colors. Gear oils and opaque materials are often classified as to their reflected light colors. (Light Green, Dark Green, Blue, Brown, etc.). Lower viscosity and more highly refined materials are usually color classified by transmitted light.

Lubricating oils range in transmitted light from colorless medicinal oil type material through yellow, orange, and cherry to dark red colors. Colors are reported according to number—the numerical scale starting with 1 and ending with 8. As well as this A.S.T.M. test method, there are other methods such as Tag-Robinson and Lovibond.

Color is not necessarily an index to stability. Many light-colored oils are definitely less stable as regarding lubrication use than are some darker-colored products.

There is no necessary relation between color and viscosity. Some are inclined to relate lighter color with lower viscosity. This is not necessarily true.

For most lubrication problems, color is not an important factor. In the textile industry, however, it can be of importance because of staining of fabric.

Lubricants are often refined to colors which refiners feel are required consistent with quality for their particular products, but these colors, in many cases, are never seen because the incorporation of many additive agents impart color. In some cases, lubricating oils, like gasolines, are dyed to desired colors.

Gravity

Of all the oil specifications written over the past years, there have probably been more gravity test values included than any other. As an indication of product usefulness or quality, it has little significance. While there was a time when the source of the crude oil from which a lubricant was taken being spotted by means of the lubricant gravity, this is no longer true, due largely to the advent of solvent extraction refining processes which remove less paraffinic types of compounds from the lubricants and make them more paraffinic.

Gravity, as measured and reported on normal petroleum products, are usually measured by means of the A.S.T.M. Hydrometer method. Results are reported in degrees A.P.I. This system is an arbitrary one, but has a definite relation to specific gravity.

Other than being a ready means for determining the weight per unit volume of petroleum products, it finds wide use in refinery control. Where lubricants are sold on a weight basis and delivered on a volume basis, the gravity test is useful in converting from pounds to gallons.

Viscosity

The viscosity characteristics of a lubricant are probably its most important property. If viscosity is defined as the measure of the resistance which a lubricant offers to flow, it becomes evident that unless viscosities are kept to a minimum value, much mechanical effort will be lost in overcoming viscosity effects in a lubricated system.

It can be shown that ease of starting in cold weather and oil consumption are both governed in gasoline engines by the viscosity of the lubricant and it is also true that viscosity is related to temperature, hence the viscosity-temperature relationships of lubricants are of importance. This relationship is shown by use of the A.S.T.M. Viscosity-Temperature Chart. The chart is used by plotting two measured viscosity values on it and drawing a straight line through these values, extending this line beyond the measured values for the purpose of allowing extrapolated readings to be made. The measured values used are generally those taken at temperatures of 100 F, 130 F, or 210 F. Charts are available for plotting either Kinematic Viscosity or Saybolt Viscosity.

It is generally agreed that as viscosity increases, oil consumption decreases to some critical value dependent upon mechanical and operational conditions for any engine, and then consumption will again increase.

During cold weather, the temperature at which a gasoline engine will start is often a problem. From a lubricant standpoint, viscosity is the controlling factor. As an engine and its lubricant become colder, the lubricant viscosity increases and the limiting starting value is eventually reached.

In order that the average engine be startable at 0 F, a maximum lubricant viscosity of about 10,000 Saybolt seconds is usable. If the temperature is -10 F, a lubricant having a viscosity of about 2,500 Saybolt seconds as measured at 0 F, not -10 F, is maximum. A viscosity of 2,500 seconds at 0 F is equivalent to 10,000 seconds at -10 F, for our purpose.

The viscosity-temperature characteristics of all lubricating oils are not the same. Oils which show the smallest change in viscosity for a given temperature change are referred to as high Viscosity Index oils while those exhibiting the greatest change are classified as low Viscosity Index oils. Lubricants made from Pennsylvania type crude oils are classified as high V.I., whereas lubricants made from naphthenic type crude oils are known as low V.I. It is possible to convert low V.I. oils to high V.I. oils by present refining methods and it is also possible to increase the V.I. of Pennsylvania type lubricants by the same method.

Where high V.I. is desired, it is also possible for the refiner to secure it by the incorporation of certain addition agents to the lubricants. These materials are often not too stable when subjected to high shear stress with the result that the high V.I. characteristics as measured on the product in the laboratory may be lost in service.

Lubricants are used to keep moving parts separated, substituting a fluid film for metal to metal contact; hence, it is important that at operating temperatures the viscosity of the fluid be of such magnitude that a fluid film be maintained irrespective of the load placed upon it.

If the viscosity be too great, excessive fluid friction results. This means higher heat generation in bearings, a reduced rate of oil flow, and loss of power.

Flash and Fire Tests

Both of these tests are very roughly related to the tendency of a lubricant to vaporize. The fire point, however, adds little to one's knowledge which was not learned from the flash point. The Cleveland Open Cup apparatus is that most generally used.

Flash points were originally devised to assist in determining the fire hazard encountered through the use of light oils such as kerosene. Lubricating oils do not pose fire-hazard problems; hence, the test is of little value for this reason. The test is sometimes useful in determining the presence of small quantities of moisture in lubricants in that very small quantities of moisture will, during the flash point determination, cause the lubricant to foam in the test cup or to audibly "crackle" very profusely.

The flash point is still considered by some buyers as a useful criterion of applicability in that they relate high flash points of Steam Cylinder oils to Pennsylvania crude origin and feel that high flash oils are less liable to decomposition.

The use of high flash oils has been felt necessary by some as assurance against spontaneous ignition when used in air compressors. This is not necessarily so, however, in that flash-point is not a criterion of such ignition temperatures.

Consistency

Lubricating greases, unlike lubricating oils, do not possess true viscosity properties. Greases, when subjected to pressure, will flow and the pressure-flow characteristics are known as the consistency. Where fluids such as oils possess viscosity plastic substances such as greases, petrolatum, solidified oils, soap thickness oils, etc, possess the property of consistency.

There are a number of methods used to measure this property of greases. Two which are being used widely are the A.S.T.M. consistency test and the pressure viscometer. In the former test, the consistency is measured by allowing a metal cone of definite shape and weight to drop into a container of the grease for a 5 second time interval. The depth of penetration of the cone into the grease, measured in units of 1/100 of a centimeter, is recorded as a measurement of its consistency. Grease temperature, length of time the cone is permitted to drop into the grease and the amount of handling or working which the sample has encountered prior to testing will all influence the consistency measurement.

Consistency measurement under one set of conditions tells virtually nothing as to consistency under different conditions; hence, it is necessary to gather through experience, sufficient knowledge of the relation between the above measured consistency and service performance to know what is a satisfactory consistency in commercial use for a particular type of grease.

This type of consistency measurement is applied to unworked as well as to worked greases. Block grease is an example of a type of product whose unworked

consistency is usually measured while a cup-grease is an example of a type whose worked consistency is usually required.

Commercially, greases are classified according to their worked consistency. This classification was worked up by the National Lubricating Grease Institute and has been adopted by the industry.

The pressure viscometer is a device used to determine grease consistency over a wide temperature range and at varying rates of flow and shear. Essentially it consists of a grease reservoir into one end of which can be placed steel capillaries of various sizes and into the opposite end oil is pumped at a constant rate. In operation, the pressure of the pumped oil forces the grease through the capillary at a constant rate, which is the pumping rate of the oil pump. The grease temperature is measured by means of a thermocouple. The conditions of test give sufficient data so that the "apparent-viscosity" of the grease can be calculated.

Examples illustrating the manner in which this test can be utilized are as follows:

1. Determination of dispensibility of grease at low temperature.
2. Consumption of grease in shackle lubrication.
3. Manufacture control of consistency over a range of shear rates to make certain of uniformity.

The term consistency is also used in describing grease texture where such terms as "spongy," "fibrous," "stringy," "smooth," and "tacky" are commonly used.

Dropping Point

Greases as used commercially, can and do encounter temperatures at which their consistency undergoes an abrupt change and they seem to melt. Knowledge of this temperature adds to the users ability to judge the usefulness of the product for his application. This temperature has often been referred to as melting point, which is a misnomer in that the grease is not going through this change by virtue of melting point alone. Currently, this point is called the dropping point, for the reason that it is the temperature at which a drop of heated grease falls from the test equipment.

The test consists of carefully heating what amounts to a small thimble full of grease into which a thermometer bulb has been partially submerged until the first drop of grease falls from a small opening in the thimble bottom.

The dropping point leaves much to be desired and cannot be relied upon to indicate the service temperature at which a grease ceases to function as a grease because of consistency change due to temperature.

The test is widely used in grease specifications by both buyer and seller and the buyer can be assured that its incorporation into a specification is an added assurance of product property uniformity. Much thought is being directed toward the development of a more meaningful test method.

Bleeding

When lubricating greases are permitted to stand either in bulk quantity or in small quantity as in a packed ball bearing, they will, on occasion, separate oil from grease. This type of separation is known as bleeding. Controversy arises over the significance of this condition and it is quite generally agreed that a small amount of bleeding is not harmful, in fact may be desirable. Such a condition seems to disturb buyers however, and they tend to prefer that product which does not bleed under these static conditions.

Probably the most widely used laboratory method for measuring this condition is the Cone Bleeding Test. The wide use of this test method in governmental specifications is undoubtedly the reason for its wide use today.

As to the usefulness of this method, the Grease Advisory Group of the C.R.C. War Advisory Committee reported[2] in the fall of 1944 to the effect that the test is not suitable for evaluating the tendency of greases to separate either in bulk or in equipment in which they may be used.

General

While it has not been mentioned during the course of this discussion, it should be said in closing that most of these testing procedures are very helpful to the refiner in that they assist him in producing a uniform product. Such tests as gravity, viscosity, flash point, pour-point and others are relatively "quick" tests and are widely used by him in controlling his refining operations. Without such testing methods uniformity of product would not exist. For a particular type of operation and specific lubricant, correlation of some test procedure with service is possible and the use of these procedures can often guide the engineer in doing a good lubrication job.

This table illustrates the manner in which oils may revert in pour point. These oils were stored out of doors and were examined daily over a winter. It is to be seen that A.S.T.M. Cloud Point and/or Pour Point are not indications of the reversion in the field.

POUR POINT REVERSION

Sample	A.S.T.M. Cloud F	A.S.T.M. Pour F	Max. Temp. Solid in Field F	Pour Reversion F
1	34	—30	22	52
2	34	—15	22	37
3	34	—5	—2	3
4	44	—30	18	48
5	38	—15	4	19
6	32	20	4	16
7	22	—10	12	22
8	8	—20	—13	7

To illustrate the lack of correlation between the so-called neutralization number (A.S.T.M. Acid Number) and bearing corrosion, this table was prepared. It shows the utter lack of bearing weight loss in relationship to the Acid number of the original unused oil as well as the lack of correlation between bearing weight loss and Acid number after the standard 24-hour L-4 Chevrolet test.

A.S.T.M. ACID No.—BEARING ST. LOSS

Oil No.	Original Acid No.	After Chevrolet L-4 Test	
		Bearing Weight Loss (Grams per Bearing)	Acid No.
1	0.52	0.06	0.35
2	0.54	0.09	1.15
3	0.45	0.40	1.00
4	0.05	0.66	3.63
5	0.05	1.25	1.05
6	0.95	0.98	1.03

RATING SALE

Rating	Weight Loss per Bearing
Good	Up to 0.35 Grams
Fair	0.35 to 0.75 Grams
Poor	Over 0.75 Grams

This table illustrates the relationship existant between A.P.I. gravity, Specific Gravity and weight in pounds per gallon for petroleum oils.

[2] W. G. Ainsley: Report on the Activities of the Coordinating Research Council War Advisory Committee — Grease Advisory Group. Twelfth Annual N.L.G.I. meeting. The Institute Spokesman, Vol. VIII, No. 10, page 3.

It is not to be construed that the A.P.I. gravity scale terminates with either 10 or 30 degrees. This range was selected for the purpose of illustration only.

GRAVITY-WEIGHT RELATIONSHIP

Gravity A.P.I.	Specific	Weight (Lb/Gal)
10	1.0000	8.328
15	0.9659	8.044
20	0.9340	7.778
25	0.9042	7.529
30	0.8762	7.296

Grease consistency is classified in accordance with the National Lubricating Grease Institute system. The classification number and the A.S.T.M. Penetration range defining each classification number is shown in this table.

The grade classifications zero through 6 constitute the entire range of N.L.G.I. consistency classification.

N.L.G.I. GREASE CONSISTENCY CLASSIFICATIONS

Grade	A.S.T.M. Penetration (worked)
0	335—385
1	310—340
2	265—295
3	220—250
4	175—205
5	130—115
6	85—115

The apparent viscosity of grease is influenced by the rate of shear in a manner illustrated by Fig. 1.

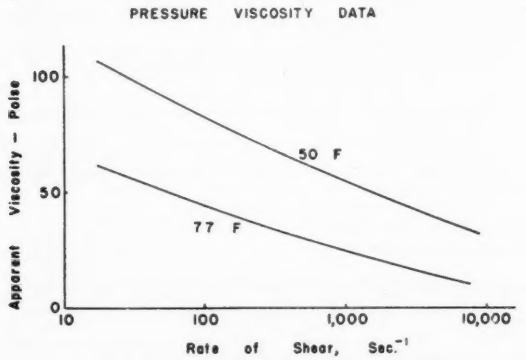

Fig. I. Representative Apparent-Viscosity, Shear-Rate Curves.

As the rate of shear increases, the apparent viscosity decreases. For a given shear rate, the apparent viscosity increases as the temperature of measurement decreases.

Discussion by Mr. Matthew N. Hayes,

Chemist, Houde Engineering,

on the Papers of Messrs. Hulme, Eismann and Roehner and Carmichael

Mr. Ehrlich has asked me to comment upon the papers just presented as they apply to the field in which I am particularly interested. Our field is that of damping devices in which the oil serves the dual purpose of lubricant and hydraulic medium.

Before we can consider the details, let me point out that in most of our equipment very high shear rates exist. For example, in the average automotive shock absorber four ounces of oil must pass through an orifice having one square millimeter of area under a pressure of 2500 p.s.i. in a time of approximately one-half second. Under these conditions, the viscosities and viscosity temperature characteristics, as described to you by Mr. Hulme in his paper "The Significance of Lubricating Oil Tests," are not necessarily conclusive. For example, we have found, as I am sure many of you have, that when pour point improvers or vicosity temperature coefficient improvers have been added, while the curve as shown by a standard viscosimeter is very good, the results as shown by mechanical tests on a device such as a shock absorber are closer to those of the base oil before the inclusion of additives than to those indicated by the curve.

However, unlike the permanent loss of viscosity shown when certain of the high polymeric materials such as Vistanex are subjected to high shear rates, the oils which are blended to give good viscosity characteristics break down under the high shear rate but return to apparently good viscosity characteristics when retested in a viscosimeter. This would seem to indicate that it is the additive which is giving an artificial viscosity. However, we have tested samples which we were assured were straight petroleum refinery products containing no additives whatsoever which still give apparently this same characteristic; that is, under a high shear they apparently break down, but under further low shear rate tests they return to normal.

Somewhat the same remarks may be applied to the standard A.S.T.M. pour point determination. It has been noted that some oils which have high or relatively high pour points will flow better under high pressure at considerably lower temperatures than will other oils which have much lower A.S.T.M. pour points.

Based upon our own experience, of which the above examples are only the most common phenomena, we agree most heartily with the opinion as expressed by Mr. Carmichael in his paper "Certain Functional Tests for Lubricants and Their Interpretation," namely that for the final complete interpretation of results, the conventional tests of oils and lubricants must be supplemented by functional tests simulating as closely as possible the conditions under which the given oil is to be used.

In the examples as I have mentioned, you will note that I have not given the reason why any of these phenomena exist. I do not know the reason. I only wish all of you who may be puzzled by these phenomena to know that plenty of other people are suffering from the same headaches.

SUN "JOB PROVED" PRODUCTS CUT COSTS,

Sun products have been "Job Proved" in the lubrication of almost every type of mining, manufacturing, power, and transportation equipment . . . in refrigeration and air-conditioning . . . in metal cutting, tempering, and quenching . . . in the processing of textile fibers, leather, natural and synthetic rubbers . . . in the impregnation of electrical, electronic, and packaging materials of many kinds.

To help you solve your production problems, Sun Oil Company offers a wide selection of "Job Proved" petroleum products, plus the experience of Sun Engineers. Their know-how and detailed product information are yours for the asking. Call your local Sun office, or write Dept. L-2.

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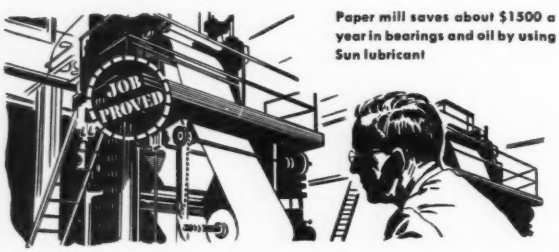
INDUSTRIAL OILS

SUNVIS 900 OILS—High-viscosity-index, paraffinic-type oils—of uniform O F pour point—fortified against rust, corrosion, oxidation, and sludge. The finest available lubricant for turbines, hydraulic systems, and similar applications.

SUNVIS HD 700 OILS—High-viscosity-index oils containing additives which minimize oxidation and give detergency. Ideal lubricants for internal combustion engines subjected to continuous heavy loads under the most adverse conditions.

SUNVIS OILS—Solvent-refined paraffinic-type oils of uniform high viscosity index, low pour point, and low carbon content. Especially suitable for application to long-time use in all types of industrial reservoirs and circulating systems.

DYNAVIS OILS—Low-pour-point, high-viscosity-index, inhibited oils, containing an additive which helps prevent formation of harmful corrosive and sludge-forming acids. Well suited for engines fitted with alloy bearings and operated at high temperatures.



Paper mill saves about $1500 a year in bearings and oil by using Sun lubricant

SOLNUS OILS—Well-refined straight mineral oils. Stand up under hard use for long periods of time. Recommended for use in machine tools, air compressors, certain types of diesels, etc.

CIRCO OILS—Used for general lubrication of industrial machinery when straight mineral oils are required.

SUNTAC OILS—100%-petroleum products which have been compounded to increase their adhesiveness. Recommended for general lubrication of all machines subjected to sudden shocks and load reversals. Cling to the parts to be lubricated.

STEAM CYLINDER OILS—High flash and fire point lubricants for either saturated or superheated steam conditions and for worm-gear speed-reduction units.

SUN CAR JOURNAL OILS—Dark oils meeting A.A.R. Specifications. For use in waste-packed bearings of railroad equipment.

SUN DELAWARE OILS—Dark oils for general lubrication on older types of industrial machinery.

SUNOCO WAY LUBRICANT—For use on tableways. Eliminates chatter and scoring . . . resists corrosion. Has good metal-wetting and adhesive properties, ample viscosity, and E. P. qualities.

SUN MARINE ENGINE OILS—Compounded with special emulsifying agents in order to provide adhesion to, and lubrication of, working parts in the presence of water. For the lubrication of bearings, eccentrics, crossheads, and various other parts of steam engines.

ROCK DRILL OIL—High-film-strength adhesive oil. For use in jackhammers, stopers, drifters, and similar equipment.

INDUSTRIAL GREASES

SUN CUP GREASES—Water resistant. For grease-cup and grease-gun application when service is normal.

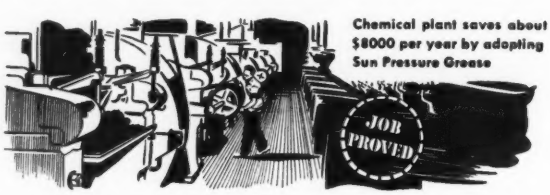
SUN GUN GREASES—Smooth greases made with medium-viscosity oil. Stable under pressure in power and booster guns.

ADHESIVE PRESSURE GREASES—Won't drip or splash. Excellent lubricants for open-gear applications.

SUN DARK PRESSURE-SYSTEM GREASES—For power-driven central grease lubricating systems in heavy industries. Also used as a "medium cup grease."

SUN MINE CAR GREASES—Available in several grades. Suitable for both antifriction bearings and plain-bearing cavity-type wheels.

SUN MINING MACHINE LUBRICANT—Semifluid. For use where a light but adhesive grease is required. Resists separation and decomposition.



Chemical plant saves about $8000 per year by adopting Sun Pressure Grease

SUN ROLLER BEARING GREASES—For use on electric motors and generators and high-temperature machinery equipped with ball or roller bearings.

SUN GEAR COMPOUNDS—Black adhesive open-gear compounds and

"JOB PROVED" IN EVERY INDUSTRY

SUN PETROLEUM

SPEED PRODUCTION, IMPROVE QUALITY

wire-cable greases. Recommended for power presses, mining machinery, worn reduction mills, crushers, pump gears, etc.

SUNOCO TRACTOR ROLLER COMPOUND—For crawler-type tractors. Provides good lubrication with exceptional sealing qualities.

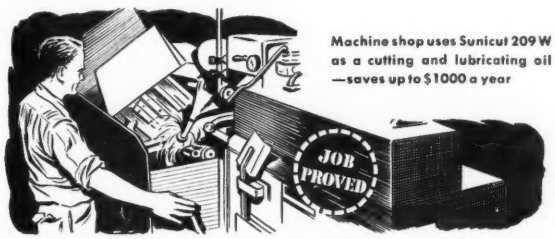
METALWORKING OILS

SUNICUT—Straight (non-emulsifiable) transparent cutting oils. Recommended for automatic screw machines and heavy-duty machining operations. Permit high speed production with excellent finishes, long tool life.

SUNOCO EMULSIFYING CUTTING OIL—A self-emulsifying oil which produces a stable white emulsion. Efficient and economical cooling and lubricating medium for turning, milling, drilling, and other metalworking operations on both ferrous and nonferrous metals. It is also an excellent grinding coolant.

SUN QUENCHING OILS—Specially refined oils designed to aid development of maximum physical properties in a wide variety of steels.

SUN TEMPERING OILS—Specially refined oils for tempering steel. Because of their low carbon content and stability under heat, these oils have an unusually long service life.



Machine shop uses Sunicut 209 W as a cutting and lubricating oil —saves up to $1000 a year

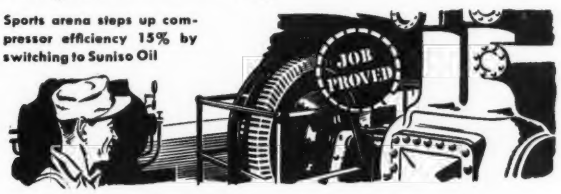
SUN ROLLING OILS—Straight and emulsifying oils which will permit maximum production in rolling steel, aluminum, brass, and copper.

SUN ANTI-RUST COMPOUNDS—Petroleum-base oils with chemical additives designed to prevent the rusting and corrosion of steel.

REFRIGERATION OILS

SUNISO REFRIGERATION OILS—Have extremely low pour points, extremely low wax-separating characteristics, a high degree of stability and long life. Initially neutral and resistant to formation of detrimental acids under service conditions. Suniso Oils are high quality oils suitable for both high- and low-temperature operations. The most widely used oils in refrigeration and air-conditioning.

Sports arena steps up compressor efficiency 15% by switching to Suniso Oil



TEXTILE-PROCESSING OILS

SUNOTEX TEXTILE OILS—Designed to impart certain additional properties to various forms of fibers during their processing from the fiber state into a manufactured product. All Sunotex textile oils are emulsifiable in water. Highest rating in fadometer tests.

SUN COTTON CONDITIONING OILS—Pale mineral oils which condition the cotton. They prevent waste by cutting down excessive amounts of "fly" (fine air-borne lint particles).

Worsted mill obtains easier scouring, better quality, larger yield with Sunotex WO-220

SUN ASBESTOS FIBER CONDITIONING OIL—Used for spraying on the asbestos during processing. Fibers are kept from being damaged or broken down, and harmful dust is minimized when this product is used.

SUN CORDAGE OILS—Generally used alone, but are adaptable to various formulas used by cordage manufacturers. Selected products, highly compatible with additives.

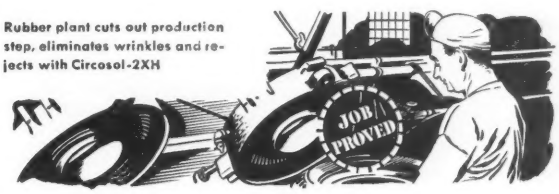
RUBBER-PROCESSING AIDS

CIRCOSOL-2XH—An elasticator and processing aid for natural rubber and especially for GR-S. Outstanding for sponge rubber.

CIRCO LIGHT PROCESS AID—A processing agent and excellent softener for natural rubber, natural rubber reclaims, and neoprene synthetic rubber. Used for GR-S to some extent.

SUNDEX-54—An inexpensive product suitable for processing GR-S and blends of GR-S and natural rubber. An established processing aid for rubber footwear stocks and semihard rubbers.

Rubber plant cuts out production step, eliminates wrinkles and rejects with Circosol-2XH



CIRCOMAR-5AA—A black-colored product for processing natural and GR-S rubber used in tire-making. Also used in reclaiming natural-rubber scrap. Replaces asphalt fluxes. Free-flowing at room temperature.

WAXES

Sun's new wax plant will be completed in 1949. Its many refining innovations and extreme flexibility will permit new types of waxes to be manufactured in large quantities—a procedure heretofore impracticable. A wide range of fully refined paraffin and microcrystalline waxes will be "tailor-made" to meet the requirements of virtually all major industrial applications. Pilot plant samples of several grades are now available.

MISCELLANEOUS INDUSTRIAL PRODUCTS

SUN SOLVENTS—Sun Spirits for the thinning of paints, varnishes, and enamels, and for metal-cleaning . . . a pure, water-white petroleum solvent free of corrosive sulphur. Other Sun solvents with special properties are available for the chemical industry.

SUN LEATHER OILS—Mineral-base leather oils. Used for obtaining the desired tensile strength, proper temper, and controlled moisture content. Maintain a light even color . . . mix well . . . distribute evenly.

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PRODUCTS

SUNOCO

Discussion by Mr. George Steven,

Executive Engineer, Worthington Pump & Machinery Company,

on the Papers of Messrs. Hulme, Eismann and Roehner and Carmichael

The subject papers are interesting in their description of the various test procedures for evaluating certain characteristics of lubricating oils, but do not add material knowledge to the problem of the user who is faced with the lubrication of specific mechanical equipment. As manufacturers of mechanical equipment, namely: compressors and internal combustion engines, we are faced with the problem of specifying what in our judgment is satisfactory lubrication for these units. In order to maintain our relations on a satisfactory basis with all the oil companies it is necessary that we deal with a specification only, which generally has to be sufficiently broad to embrace all the competing oil distributors.

We recognize that advantage can be taken of specifications, and cheaper grades of oil recommended, which technically are embraced by the latitude which these specifications cover and have taken suitable steps to prevent such happenings as much as possible.

It must be recognized that the average user of lubricants cannot provide himself with facilities for making periodic tests of the lubrication in service as outlined in the papers previously mentioned, so that it would seem advisable for recognized laboratories to be strategically located enabling consumers at large to obtain prompt analysis of the condition of the lubricant in their equipment and apply the knowledge of evaluation of these tests to circumvent any difficulties which may develop. In my experience with lubrication recommendations, I have frequently noticed a tendency on the part of lubricating engineers to always search for a different grade of lubrication as a means of correcting a difficulty which frequently developed to be a mechanical discrepancy, which discrepancy had to be first corrected before any grade of lubricant could have ever functioned.

It would seem almost impossible to expect the average lubricating engineer to be sufficiently expert to diagnose mechanical difficulties or inadequacy of design in the variety of equipment which he is called upon to prescribe for, and it would be well to adopt a policy of more closely contacting the original manufacturers instead of attempting to solve the problem by himself, unless of course, it is obvious that the quantity or grade of lubricant is inferior.

Cases have developed where an over-enthusiastic lubrication engineer has attempted to assume the entire burden by himself to his ultimate detriment as well as frequently considerable back-charge to the original equipment builder; this could be called functional testing at the expense of the equipment manufacturers. Admitting that engineers in general are highly intelligent people, it is nevertheless out of the question to expect all of them to obtain a truly comprehensive knowledge of lubricating oil such as a specialist in that field might acquire. What the average engineer does want is a simple explanation of the characteristics and if possible some explanation of the significance of analysis report and what bearing this analysis might have on his particular type of equipment.

In other words in an internal combustion engine what are the indications in a lubricating oil analysis that would show the operator what might be going wrong in the engine itself which requires correction in order to insure the quality of lubrication being maintained at desirable level. Similarly with all other types of equipment such as steam engines, compressors, etc.

When it comes to bearing lubrication, there are certain fundamental requirements which must be met, insofar as the quantity of lubrication to be circulated, the proper temperatures to maintain and the disposition of the lubrication through the bearing itself by whatever means are necessary to produce uniform distribution.

Inasmuch as specifications seem to be the only means of recommending lubrication it would seem imperative that the lubricating oil companies establish specifications which are entirely descriptive and which cannot be circumvented to the extent that a cheap, low quality product can be furnished and still technically meet the specification requirement.

Discussion by Mr. Melville Ehrlich,

American Lubricants, Inc.,

on the Papers of Messrs. Hulme, Eismann and Roehner and Carmichael

From the discussion of lubricant testing it would seem that certain facts stand out:

(1) Many, if not most, lubricant tests are of value only to define the product so that control may be achieved. In this way, successive batches may be kept nearly identical when produced, or when received. Or the values may be used to indicate progressive changes in a lubricant. These tests, such as gravity, neut. number, or interfacial tension, have *no* relation to quality—only to the identity of a lubricant. When so applied, they have great utility.

(2) Many laboratory tests of lubricants were developed in the hope that they would relate to quality or usefulness. Such tests do indicate that certain products would *not* work in specified applications. We might call these screening tests. When used this way, or as control tests, they make sense. Flash point, pour point, viscosity, penetration, carbon residue — when properly applied, they are useful. As general indicators or as the sole criterion of whether a certain lubricant is useful for a specific application, they are *not* applicable, and can cause a great deal of argument and grief.

(3) The most remarkable advance in lubricant testing during the past decade is in the functional testing of lubricants. Since functional tests are expensive, they are not to be found or casually set up in every laboratory. And since functional tests are usually run under a narrow range of conditions, whereas in use anything is encountered, such tests are not always applicable. But again—when properly applied, often in conjunction with other tests, they give us the nearest approach to a true indication of quality.

(4) The final criterion is field application. As we learn more about actual performance of lubricants of definite laboratory measure, we approach the time when more of the "performability" of a lubricant can be expressed in terms of lab test values. As of today, we are not in general able to state laboratory figures which will predict the quality of a lubricant as measured by field results.

Tests are our tools—our servants. They are vital and indispensable servants—as long as we do not let them become our masters.

THE MECHANISM OF FRICTION AND LUBRICATION

The author's reply to the comments published in LUBRICATION ENGINEERING *4*, 214-216, 235 and 238 (October 1948)

By J. J. BIKERMAN
Research Laboratories, Merck & Co., Inc., Rahway, N. J.

1. Mr. S. J. Needs believes his experimental results[1] to be inconsistent with the mechanical explanation of the enhanced apparent viscosity in thin films, as advanced in my paper[2]. In his experiments, the approach of two parallel plates ceased when the distance between them was, e. g., 3×10^{-5} or 4×10^{-5} inch (i. e. 8×10^{-5} or 10^{-4} cm.). In terms of the mechanical theory one would conclude that dust particles or surface hills of this height were present on one or both of the plates. Mr. Needs does not agree with this conclusion and states that the surfaces used were "flat to better than one-millionth of an inch including the edges." Frankly, I do not know how such surfaces can be prepared and preserved, especially in the ordinary laboratory air, nor how the absence of any elevation taller than about 10^{-6} cm. was proved.

The increase in the viscosity of olive oil between two steel discs at rest and its lowering by agitation certainly deserves attention. This viscosity change may be an example of thixotropy. However, a convincing interpretation is impossible now, after a lapse of 10 years, as it would require an additional experimental investigation. A study would be needed of the mechanical performance of the apparatus used, of chemical changes at the iron-oil boundary, of the effect of displacing the "aged" oil by a fresh and freshly filtered oil sample, etc.

2. An important remark is made by Mr. F. Morgan. He doubts the possibility of attributing the difference between the experimental and the theoretical values for the "coefficient of friction" in journal bearings to anomalies of the apparent viscosity and writes: "Since the Sommerfeld variable is a composite function, including both velocity and pressure, the viscosity would need to possess very unusual characteristics if a single friction curve is to be obtained even for a specific journal bearing combination." However, the Sommerfeld variable appears as a composite function only because it is expressed in measurable quantities. According to the hydrodynamic theory of lubrication,[3,4] this variable is a measure of the eccentricity of the journal, that is also of the actual (as distinct from the average) film thickness of the lubricant. If experiment shows that, for a specific journal bearing combination, the "coefficient of friction" is a definite function of the Sommerfeld variable, we are entitled to conclude that the apparent viscosity of the lubricant is a definite function of the film thickness. This would be in perfect accord with the theory attributing the high values of apparent viscosity to surface roughness. When different journal bearing combinations are compared, the "friction" values do not coincide but are different for surfaces of differing roughnesses.[5]

Bulkley[6] and Bastow and Bowden[7] showed that molecular chains in liquids, postulated by some proponents of the chemical theory of lubrication, do not exist. In agreement with the mechanical theory they proved that, if the mechanical obstacles are removed, the viscosity is correct (within 10%) down to slits 2×10^{-4} cm. wide or capillaries 10^{-3} cm. in diameter.

The increase of initial wear with the degree of surface roughness can be explained by referring to Fig. 4 of my paper[2]. If hill A hits hill B with such a force that B (or A, or both) is broken off, the alteration of the surface is greater the greater is hill B (or A, or both).

3. I emphatically agree with Mr. L. C. Roess that the ambiguity of the term friction is unfortunate. If *friction* is used in the wide sense of *resistance to sliding*, then the expression *the law of friction* should be removed from all our textbooks (in which it means Coulomb's law of dry friction), because there is no law common to all types of sliding. I think that the American Society of Lubrication Engineers would render a distinct service to our science if it would appoint a nomenclature committee for standardizing the terms which describe the different kinds of the resistance to sliding.

Mr. Roess refers to plastic and elastic deformations of surface hills. Plastic deformations are considered in section V (on scratching) of my paper[2]. Elastic deformations are undoubtedly important because they influence the angle of slope of the hills, over which the slider must climb. However, the modulus of elasticity can be varied within wide limits without affecting the range of validity and the numerical constant of Coulomb's law of dry friction. This seems to show that the work expended on elastic deformation is not very important as long as Coulomb's law is valid. I do not expect Coulomb's law to be valid for soft rubber and similar materials.

4. Metal to metal contacts are mentioned in all three comments. These contacts generally do not occur in any of the types of sliding dealt with in my paper, and also wear (abrasion) does not necessarily imply any metallic contact. This is proved by two sets of observations, namely (a) the absence of true adhesion between two metal pieces "in contact," and (b) the profound similarity between the friction, scratching, and abrasion effects in metal—metal systems on one hand and in systems such as quartz-metal, wood-metal, wood-wood, etc., on the other hand.[8]

Mr. L. C. Roess offers two "plausible word pictures" of boundary lubrication. Since both are based on "welding" which does not exist in boundary lubrication, these word pictures cannot be accepted.

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[1] S. J. Needs, Trans. Am. Soc. Mech. Engrs. *62*, 331 (1940).

[2] J. J. Bikerman, Lubrication Engineering *4*, 208 (1948).

[3] A. Sommerfeld in General Discussion on Lubrication and Lubricants, Institution of Mechanical Engineers, London 1937 1, 297.

[4] M. D. Hersey, Theory of Lubrication. 2nd printing. Wiley & Sons. New York 1938, p. 60.

[5] J. T. Burwell, J. Kaye, D. W. van Nymegen and D. A. Morgan, J. Applied Mech. *8*, 49 (1941).

[6] R. Bulkley, J. Res. Nat. Bur. Stand. *6*, 89 (1931).

[7] S. H. Bastow and F. P. Bowden, Proc. Roy. Soc. London A *151*, 220 (1935).

[8] J. J. Bikerman, Rev. Modern Phys. *16*, 53 (1944).

CURRENT LITERATURE

Aeronautical Engineering Review, Vol. VII, No. 11, November, 1948

GAS TURBINE FUELS AND LUBRICANTS
Murray, H. A. and Bailey, B. S.—p. 59 (Aero Digest, Vol. LVII, No. 1, July, 1948, pp. 58-60, 95, 98, figs. 1 reference)

Specifications and characteristics of fuels and lubricants for turbojet and turboprop aircraft engines are discussed in detail.

Analytical Chemistry, Vol. XX, No. 8, August, 1948

DETERMINATION OF FUNCTIONALITY IN METHYL SILICONE SYSTEMS
Roedel, G. F.—pp. 705-707

Oil viscosity and oil test methods are described for determining small amounts of mono- and trifunctional methylsiloxane units in primarily difunctional methylsiloxane systems. Such information is important in the preparation of silicone oils and silicone rubber. The methods used are described and the results are discussed.

RAPID EVALUATION OF SOLVENT EXTRACTION PROCESSES, NEW LIQUID-LIQUID EXTRACTOR
Bewick, H. A., Currah, J. E. and Beamish, F. E.—pp. 740-743

A convenient continuous liquid-liquid extractor for evaluation of solvent extraction processes and for routine analytical procedures may be used with solvents heavier or lighter than the extracted liquid. A new value, the half extraction volume, for the comparison of the efficiency of continuous extractions is described. The half extraction volume is related to the distribution factor and is easily and rapidly determined by use of the new extractor. The characteristics of the extraction during the entire course of the operation may be followed. Examples of the use of the extractor and the half extraction volume are given.

Vol. XX, No. 10, October, 1948

VISCOSITY BLENDING RELATIONSHIPS OF HEAVY PETROLEUM OILS
Rahmes, M. H. and Nelson, W. L.—pp. 912-915

The paper was presented before the Oklahoma Section of the American Institute of Chemical Engineers, Bartlesville, Okla., October 11, 1947. A total of 30 petroleum oil systems, using 17 different oils, was investigated. Each system was investigated at three or more compositions. The results were compared with viscosities predicted by a number of methods that have been proposed in the literature. The Wright method, a new way of using the A.S.T.M. chart for predicting blend viscosities, was found to give the best results in most cases. It was concluded that the use of viscosity-temperature characteristics of the component oils, as in the Wright method, is a definite improvement in viscosity prediction methods.

American Petroleum Institute Twenty-Eighth Annual Meeting, Chicago, Illinois, November 9-10, 1948.

LUBRICANT REQUIREMENTS FOR THE AUTOMOBILE ENGINE OF THE FUTURE
Colwell, A. T. and Pomeroy, A. L.—17 pages

The authors attempt to indicate what some of the problems of future engines may be, because improved engines are bound to come. It is necessary to correlate high compression ratio engine design with lubrication. Two possible methods of making the necessary fuel available are under consideration: 1) the dual gasoline fuel system, and 2) alcohol-water-lead injection. The future trends of high compression ratio engines are indicated and the problems of adequate lubricating oils involving wear and engine deposits, including low-temperature sludge, high-temperature deposits, combustion-chamber deposits, valve sticking, are discussed. Bearings and cold starting are also taken up. The problems aiming at the improvements in the automobile engine and proper lubrication are summarized.

ASTM Bulletin, No. 153, August, 1948

A WORKER-CONSISTOMETER FOR LUBRICATING GREASES
McKee, S. A. and White, H. S.—pp. 90-98

An apparatus is described for mechanically working a lubricating grease and measuring its flow characteristics in the same series of operations. Test data are given showing the effect of working upon the flow characteristics of greases. The paper was presented at the meeting of A.S.T.M. Section II of Technical Committee G on Lubricating Grease of D-2 on Petroleum Products and Lubricants held February 10, 1948, Washington, D.C.

No. 154, October, 1948

THE LIGHT-WEIGHT CONE FOR PENETRATION OF SOFT GREASES
Brunstrum, L. C.—pp. 66-67

This is the report from Section II on Consistency Measurements of Technical Committee G on Lubricating Greases of Committee D-2 on Petroleum Products and Lubricants. The purpose of the report is to summarize the activities of the three programs aiming at the adaptation of the penetrometer measurements to semifluid greases.

PHOTOELECTRIC MEASUREMENT OF A COLOR INDEX OF LIQUID PETROLEUM PRODUCTS
Lykken, L.—pp. 68-73

A rapid, reproducible method for the photoelectric measurement of a color index of liquid products has been developed by Subcommittee VI on Color of ASTM Committee D-2 on Petroleum Products and Lubricants. The method depends upon measurement of transmitted light using a photoelectric colorimeter having specified characteristics and equipped with a broad-band "north sky" and narrow-bank red and violet color filters. The new method is basically more sound than visual methods based on a single discontinuous series of color standards and avoids the uncertainty of the human eye.

Chemical Abstracts, Vol. XLII, No. 19, October 10, 1948

DEVELOPMENT OF THE TECHNIQUE OF THE HYDROGENATION OF SOLID FUELS AND OF THEIR BY-PRODUCTS
Thibaut, L.—p. 7509
(Chimie & Industrie, Vol. LIX, 1948, pp 548-51)

A brief description is given of the fuel hydrogenation process used by the Cie. Francaise des Essences Synthetiques. The fuel is hydrogenated in a single chamber or tower at temperatures increasing progressively from 300 to 500°C. Products are simultaneously fractionated, light products withdrawn and heavier ones retained. Iron sulfide on active carbon and activiated with a small amount of cyanides and thiocyanates of Group V metals is used as catalyst. Its preparation is described.

LOW-TEMERATURE PROPERTIES OF OILS WHICH CONTAIN VISCOSITY-IMPROVING ADDITION AGENTS
Fuchkov, N. G.—p. 7517
(Neftyanoe Khoz, Vol. XXVI, No. 3, 1948, pp. 49-57)

"UCON" SYNTHETIC LUBRICANTS AND HYDRAULIC FLUIDS
Russ, J. M., Jr.—p. 7517
(Am. Soc. Testing Materials, Symposium on Synthetic Lubricants, Spec. Tech. Pub No. 77, pp. 3-15, discussion 12-15, 1947)

MECHANICAL PROPERTIES OF GREASES
Vinogradov, G., Pavlov, V. P. and Klimov, K. I.—p. 7517
(Neftyanoe Khoz, Vol. XXV, No. 12, 1947, pp. 47-51)

THE MANUFACTURE OF SULFURIZED CUTTING OIL, WITH SULFUR IN LUMP FORM
Golovanov, N. V.—p. 7517
(Neftyanoe Khoz, Vol. XXVI, No. 2, 1948, pp. 49-52)

TESTS ON THE DETERMINATION OF GASOLINE LOSSES IN OIL EXTRACTION
Pardun, H.—p. 7550
(Seifensieder-Ztg., Vol. LXXIII, 1947, pp. 121-4, 141-4)

This article deals with the manufacture of gasoline from oil seeds and takes up loss occurring.

A VISCOMETER FOR MEASUREMENTS DURING THIXOTROPIC RECOVERY. RESULTS WITH A COMPOUNDED LATEX
Mooney, M.—p. 7561
(Rubber Chem. and Technol., Vol. XX, 1947, pp. 585-96)

THE CHEMISTRY AND THE APPLICATION OF THE SILICONES
de Infiesta, L. J.—p. 7567
(Rev. cienc. aplicada (Madrid), Vol. II, 1948, pp. 15-21)

A review is given with 68 references.

Vol. XLII, No. 20, October 20, 1948

CHEMICAL COMPOSITION OF MINERAL OILS OF DIFFERENT ORIGINS
Lunshof, H. J., van Steenis, J. and Waterman, H. I.—p. 7959
(Chimie & industrie, Vol. LIX, 1948, pp. 535-41)

A description of the results of the analysis of a Sumatra crude oil (after removal of light gasoline) which was separated by vacuum distillation into 13 fractions and a residue which were hydrogenated under high pressure to saturated hydrocarbons with the elimination of oxygen, nitrogen, and sulfur. The results for this oil and the 3 previously examined oils are presented in tabular and graphic forms.

POLAROGRAPHIC DETERMINATION OF METALS USED IN LUBRICATING OILS
Korshunov, I. A. and Shchennikova, M. K.—p. 7968
(Zavodskaya Lab., Vol. XIII, 1947, pp. 682-6) (in Russian)

PRACTICAL QUESTIONS OF THE AGING OF LUBRICANTS
Gratzl, M.—p. 7969
(Die Technik, Vol. III, 1948, pp. 267-70)

THE INFLUENCE OF STRUCTURE ON THE BOUNDARY LUBRICATION CHARACTERISTICS OF CAST IRON
Kluge, J., Bochmann, G. and Fiddecke, L.—p. 7969
(Z. Metallkunde, Vol. XXXIX, 1948, pp. 139-42)

CORROSION PROTECTION BY EMULSIONS
Sarx, H. F.—p. 7997
(Arch. Metallkunde, Vol. I, 1947, pp. 455-6)

UNITED STATES POSITION IN THE FATS AND OILS TRADE
Lund, C. E., p. 7999
(Foreign Com. Weekly, Vol. XXXII, No. 3, 1948, pp. 3-5, 47)

CHROMATOGRAPHY AND ITS APPLICATION TO THE STUDY OF FATTY OILS
Appell, F.—p. 7999
(Chimie & industrie, Vol. LX, 1948, pp. 36-40)

RAPID DETERMINATION OF FAT IN OIL CAKES
Micaelli, O. and Desnuelle, P.—p. 7999
Bull. mens. ITERG (Inst. tech. études et recherches corps gras) 1948, No. 7, pp. 31-3)

DETERGENTS AT HOME AND IN INDUSTRY
Dutton, G. G. S.—p. 8000
(Chem. Products, Vol. XI, 1948, pp. 104-7)

A critical review and analysis of talks at recent symposium of the London section of the Society of Chemical Industry are given. Evaluation of detergents, development of synthetics, wetting agents, dispersing agents, degreasing metals, and oil-in-water emulsions, are taken up.

Chemical and Engineering News, Vol. XXVI, No. 43, October 25, 1948

MECHANISM OF GREASE LUBRICATION RE-EXAMINED
Anon.—p. 3198

"The mineral oil portion of a lubricating grease is simply a carrier for the dispersion of the soap which is the real lubricant," the sixteenth annual meeting of the Lubricating Grease Institute, in Chicago, was told. Experimental evidence and theoretical justification for the belief that the mechanism of grease lubrication has been misunderstood until this time, was presented. The tests have proved that polar soap molecules attach themselves perpendicularly to the surfaces of metals with extremely high bonding forces.

Vol. XXVI, No. 14, November 1, 1948

GREASE TESTING
Anon.—p. 3304

Equipment for testing ball-bearing grease under conditions similar to those of field use has been announced by General Electric Co. It consists of two components: the ball-bearing-grease tester and the control box.

GOVERNMENT-INDUSTRY START OIL SHALE WORK
Anon.—pp. 3495-3496

Standard Oil Development Co., has announced the arrival at the Esso Laboratories in Baton Rouge, La., of the first carload of oil shale for experimental work in processing fuel. The shale, furnished by the Bureau of Mines from a deposit at Rifle, Colo., is the first of a 1,000-ton shipment to be delivered to the Esso Laboratories. In making oil from shale, Esso engineers will use the fluidized solids technique which has been applied in catalytic cracking operations. The project, marking another forward step in government-industry development of a synthetic fuels program, is a joint undertaking of the Bureau of Mines and the Standard Oil Development Co.

Vol. XXVI, No. 16, November 15, 1948

SOHIO TO BUILD SOLVENT REFINING PLANT
Anon.—p. 3418

Construction of a $13 million solvent refining plant for lubricating oils at Lima, Ohio, has been authorized by the Standard Oil Company (Ohio). It will have a capacity of 76,000 gallons of finished solvent refined lubricating oil per day.

Chemical Engineering, Vol. LV, No. 10, October, 1948

METHOD FOR ESTIMATING DIMENSIONS OF VERTICAL CYLINDRICAL TANKS
Yokell, S.—p. 131

When it is necessary to find the most economical tank size for a given tank capacity the chart prepared on the basis of the equation presented may be used for rapid determination of the required dimensions.

Vol. LV, No. 11, November, 1948

CONTINUOUS VISCOSIMETER FOR PLANT VISCOSITY CONTROL
Franzen, A. E.—pp. 320, 322

The paper was presented before the American Petroleum Institute, Chicago, Nov. 8, 1948. To speed up and simplify viscosity testing of distillates on refinery motor-oil units, the use of a continuous viscosimeter appeared to offer promising possibilities as a rapid method for viscosity determination. This paper reports the results obtained on a typical instrument called Viscorator.

SOLVENTS
Anon.—pp. 367-368

A summary is presented of growth trends of the solvent industry. To limit the scope of this survey, the study is confined to the alcohols, esters and ketones, excluding the coal-tar chemicals such as benzene, toluene and xylene as well as the petroleum hydrocarbons. Such solvents methanol, ethanol, propyl alcohols, butyl alcohols and amyl alcohols and methyl isobutyl carbinol are covered. Statistical data on the consumption of some of these solvents are given.

Chemical Industries, Vol. LXIII, No. 2, August, 1948

GENERAL ELECTRIC COMPLETES FULL-SCALE SILICONE PLANT
Anon.—pp. 220-222

The multi-million dollar silicone plant is described which recently was completed by General Electric Co. at Waterford, N. Y., to provide additional capacity to parallel growing demand for these materials.

GULF OIL MICRO LAB
Anon.—p. 242

The new Gulf Oil Corp. micro-laboratory is described. Here microscopic instruments permit scientists to work with quantities of material ten to hundreds of thousands of times smaller than those ordinarily used in research. These smaller samples can be analyzed much more quickly than normal amounts. Other micro-laboratory advantages are the conservation of expensive and scarce chemical materials, saving of laboratory space, and ability to study substances so small as to defy analysis. A unique safety feature is that highly explosive materials may be experimented with on such a reduced scale that serious dangers are eliminated.

Diesel Power and Diesel Transportation, Vol. XXVI, No. 11, November, 1948

CONSERVING DIESEL LUBRICATING OIL
Anon.—pp. 52-54

Discussing the possible shortage of the lubricating oils which could develop in the future especially in the event of another war, and having in view comparatively high prices prevailing today for Diesel lubricating oils, the author takes up the contamination of engine oil and two processes: rerefining of the oil or the process which will bring used oils back to a condition substantially equal to new oil characteristics in all respects, and reclamation of the oil or the process which only removes contaminants such as water and solid substances (insoluable in petroleum naptha).

Vol. XXVI, No. 10, October, 1948

A FILTER ENGINEER LOOKS AT DIESEL LUBRICATION
Anon., pp. 62-65

This abstract from paper "Lubrication of the Diesel Engine From the Filter Manufacturer's Viewpoint" by W. G. Nostrand, read before the Pacific Coast Educational Conference, at Berkeley, California, on August 16, 1948, deals with the relation of oil filters to the modern Diesel engine lubricating system. Four groups of oil filters are taken up.

NEW DIESEL LUBE OIL
Anon.—p. 74

EXTREME-PRESSURE LUBRICANT
Anon.—p. 78

First note. Standard Oil Company of California has announced the successful conclusion of exhaustive field tests of a new lubricating oil for Diesel engines, which will be made available to Diesel operators throughout the company's marketing area. It is claimed that the new oil, has been successful in greatly extending the period between engine overhauls. Second note. Molykote, made by the Alpha Corporation, is a dry lubricant, consisting essentially of molybdenum disulfide powder. It has the appearance of graphite though it contains none. It is claimed that it has an extremely low friction coefficient and a capacity to prevent galling, seizing, or metal-to-metal contact under bearing pressures well over 100,000 pounds per square inch. It is equally suitable for high, low, and room temperatures. Molykote may be mixed to a paste with SAE 10 motor oil.

Diesel Progress, Vol. XIV, No. 9, September, 1948

PRACTICAL LUBRICATING OIL TESTS
Gerin, F. L.—pp. 56-57

The article describes simple means for measuring in lubricating oil, the entire group of contaminants considered responsible for all engine deposits. Test to measure deposit forming substances, test for sediment, water and scuff metal, test to determine viscosity and test to determine acidity are taken up.

Vol. XIV, No. 11, November, 1948

REGULATION OF LUBE OIL PRESSURE
Anon.—p. 43

The article discusses the regulation of lubricating oil pressure in Diesel engines. The use of pressure regulating valves can, to a great extent, maintain proper pressures in oil systems equipped with engine driven pumps. A new type of valve which has proven very successful in controlling fluid pressures to within 4 per cent of set values is described. The illustrations presented illustrate the operation of the valve.

Fuel Abstracts, Vol. IV, No. 2, August, 1948

JAPANESE ARMY RESEARCH ON AVIATION FUELS AND LUBRICANTS AT FUCHU 1046
British Intelligence Objectives Sub-Committee—p. 38
(B.I.O.S./J.A.P./P.R. Rep. 127)

The report deals with specifications of various grades of Japanese army aviation fuels, oils and greases.

INTRODUCTION OF SULFUR INTO ESTER LUBRICATING OILS 1047
I. G. Farbenindustrie, A. G.—p. 38
(F.I.A.T. Microfilm Reel LF135 (TOM205), Frame 981; U. S. Dept. Commerce, Off. Tech. Serv. PBL64825)

HIGH PRESSURE LUBRICANTS 1048
I. G. Farbenindustrie, A. G.—p. 38
(F.I.A.T. Microfilm Reel LF135 (TOM205), Frames 956-957; U. S. Dept. Commerce, Off. Tech. Serv., PBL64821)

PHYSICAL THEORIES OF LUBRICATING PROCESS 1050
I. G. Farbenindustrie, A. G.—p. 38
(F.I.A.T. Microfilm Reel LF135 (TOM205), Frame 930; U. S. Dept. Commerce, Off. Tech. Serv., PBL64813)

RELATIONSHIP BETWEEN CONSTITUTION OF PURE HYDROCARBONS AND LUBRICATING PROPERTIES 1051
I. G. Farbenindustrie, A. G.—p. 38
(F.I.A.T. Microfilm Reel LF135, (TOM205), Frames 936-938; U. S. Dept. Commerce, Off. Tech. Serv., PBL64816)

HUGEL'S VIEWS ON TEMPERATURE VISCOSITY CURVE OF LUBRICATING OILS 1052
I. G. Farbenindustrie, A. G.—p. 38
(F.I.A.T. Microfilm Reel LF135, (TOM205), Frames 939-942; U. S. Dept. Commerce, Off. Tech. Serv., PBL64817)

TESTS OF TARS AS HOT-ROLLING-MILL LUBRICANTS 982
Anon.—p. 29
(Rev. Met., Vol. XLIII, July-Aug., 1946, p. 235)

Tars suitable for rolling-mill bearings must have a softening point of the order of 114° to 122°C. and the variation in the "Ubbelohde drop test" must be slight. Coal and petroleum tars were tested, but only petroleum tars proved satisfactory.

MISCELLANEOUS INFORMATION ON FUELS, DETERGENTS AND LUBRICANTS, SPINNING BAND COLUMNS FOR FRACTIONATION 1019
Birch, S. F., Withers, J. G., Narracott, E. S. and Habeshaw, J.—p. 35
(B.I.O.S. Fin. Rep. 1646, Item No. 30, p. 6)

The columns are 1 meter long, 6 or 12 millimeters in diameter, and contain a rotor made from a long length of close-wound spring steel wire flattened into helical form in a vice. At atmospheric pressure such a column has been found equivalent to 40 theoretical plates.

POLYMERIZATION OF CHEMICALLY PURE UNSATURATED HYDROCARBONS TO PRODUCTS SIMILAR TO LUBRICATING OILS 1035
I. G. Farbenindustrie, A. G.—p. 36
(F.I.A.T. Microfilm Reel LF135, (TOM205), Frames 931-932; U. S. Dept. Commerce, Off. Tech. Serv., PBL64814)

CONCEPTS AND DEFINITIONS OF THEORY OF LUBRICATION 1053
I. G. Farbenindustrie, A. G.—p. 39
(F.I.A.T. Microfilm Reel LF135, (TOM205), Frames 945-947; U. S. Dept. Commerce, Off. Tech. Serv., PBL64819)

LATEST TRENDS IN MACHINE TOOL LUBRICATION. III. PHYSICAL AND CHEMICAL PHENOMENA INVOLVED IN MECHANISM OF LUBRICATION: REVIEW OF MODERN IDEAS RELATING TO VISCOSITY AND OILINESS. ELECTRON AND X-RAY DIFFRACTION TECHNIQUES IN LUBRICATION RESEARCH 1055
Martonfalvy, I. C. de—p. 39
(Mech. Wld., Vol. CXXIII, Mar. 12, 1948, pp. 305-308.)

COPOLYMERIZATION OF LUBRICATING OIL 1056
Metzger, H. and Ammoniakwerk Merseburg, G.m.b.H, Leuna,—p. 39
(Bd of Tr., German Div., Tech. Inform. Doc. Unit, F.D. 5535/1947)

The report analyses the properties of a product obtained by copolymerization of crude ethylene polymers with mineral oil, in order to check its suitability as lubricating oil for aero engines.

LUBRICATING OILS AND HALOGEN REFRIGERANTS 1057
Shaw, A. G. and Brandon, A. O'B—p. 39
(Mod. Refrig., Vol. LI, Jan. 1948, p. 13, Feb. 1948, p. 37)

MEDIUM-PRESSURE SYNTHESIS WITH IRON FIXED-BED CATALYSTS, AND OPERATION OF FISCHER TROPSCH SYNTHESIS IN LIQUID PHASE. INTERROGATION OF DR. H. KOLBEL 1113
Hall, C. C., Craxford, S. R., Gall, D. and Smith, S. L.—p. 51
(B.I.O.S. Fin. Rep. No. 1712, Interrogation Rep. 679, Item No. 30)

A report of an interview at the Fuel Research Station, Department of Scientific and Industrial Research, dealing with the development of iron catalysts for use in conventional fixed catalyst bed reactors, and the investigation of the possibilities of carrying out the Fischer synthesis in the liquid phase is presented.

Vol. XII, No. 7, October, 1948

ENGINE LUBRICATING OILS: EQUIPMENT AND METHODS EMPLOYED AT THORNTON RESEARCH CENTER 1255
Anon.—p. 83
(Auto. Engr. Vol. XXXVIII, (499), Mar., 1948, pp. 97-105)

An illustrated description is given of the equipment and methods employed at the Thornton Research Station of the Shell Refining and Marketing Co. for fundamental research on lubricating oils. Desirable points of the design of a test engine are discussed.

ANALYTICAL ESTIMATION OF PARAFFIN WAX IN OILS AND PARAFFIN-CONTAINING MATERIALS 1476
Engle, B. K.—p. 122
(Oel u. Kohle, Vol. XXXVII, 1941, 23-25)

Simple method is described for estimation of paraffin wax in oils. The oil is dissolved in benzene, cooled to - 20°C, filtered, and washed free from oil. After removing the solvent from the filtrate and washings, the weight and pour point of the oil are determined. The weight of paraffin wax and its melting point are also found.

Vol. IV, No. 3, September, 1948

LATEST TRENDS IN MACHINE TOOL LUBRICATION. IV. POLAR AND NON-POLAR LUBRICANT ADDITIVES UNDER MILD BOUNDARY CONDITIONS 1780
Martonfalvy, I. C. de—p. 45
(Mech. Wld., Vol. CXXIII, April 2, 1948, pp. 380-383)

The use of lubricants containing chemically active polar type additives to minimize "stick slip" is advocated. Tests showed there were two characteristically different types of additives capable of forming low shear strength solid films and that the films produced also differed in type. These two types may be classified as non polar or polar. Their characteristics are compared.

DEVELOPMENT OF SILICONE LUBRICANTS 1817
Williams, A. .E, p. 54
(Pwr Wks Engng, Vol. XLIII, May, 1948, pp. 138-140)

An outline is given of experimental investigations into the characteristics of dimethyl silicone polymer fluids for lubrication of unilaterally loaded journal bearings.

FISCHER-TROPSCH RESEARCH. TRACER INVESTIGATION BY U. S. OIL COMPANY 1820
Anon.—p. 54
(Chem. Age, Vol. LVIII, May 15, 1948, pp. 680-681)

Research on the chemical reactions by which coal and natural gas are converted into gasoline has been launched by the Gulf Oil Corporation, using radio-active isotopes. The carbon 14 experiments at about 250°F. show that the hydrocarbon gas formed has less than 10 per cent of the radioactivity it would have if the entire surface of the catalyst reacted entirely through the mechanism of alternate carbide reduction and formation.

NEW METHODS FOR TESTING GREASES 2135
Weferscheid, H.—p. 121
(Oel u Kohle, Vol. XXXVII, 1941, pp. 236-240)

Illustrated descriptions of several tests are given. Consistency, oil separation and water content tests are described.

ACTIVATION OF PARACAS BENTONITE FOR OIL DECOLORIZATION 2203
Saldana, L. A.—p. 134
(Bol. Soc. Quim. Peru, Vol. XII, 1947, pp. 197-210)

Bentonite was activated by the extraction of basic constituents in single acid treatments using aqueous sulfuric acid in different concentrations. The decolorizing efficiencies of the products were compared with that of "Filtrol."

Industry & Power, Vol. IV, No. 5, November, 1948

OIL FROM SHALE
Boyd, J.—pp. 78-79

Oil shale and petrolem experiment station of the Bureau of Mines, Laramie, Wyoming, is now in operation. The author describes laboratories, gives estimates of recoverable oil, tells what shale oil is, and discusses process development.

DEVELOP NEW TYPE OF SYNTHETIC LUBRICANTS
Russ, J. M., Jr.—pp. 80-82

For more than 10 years synthetic fluids and lubricants of the polyether type have been progressing through various stages of development, both water-soluble and water insoluble products finding a variety of industrial applications for their special properties. Desirable viscosity-temperature relations, low pour points, resistance to sludge as well as varnish formation and minimum effect on most natural and synthetic rubber compositions are some of the characteristics described by the author. Synthetic lubricants and fluids may be used alone or combined with other liquids as industrial hydraulic fluids in equipment which requires good lubricating action.

The Institute Spokesman, Vol XII, No. 5, August, 1948

FATS AND FATTY ACIDS IN LUBRICATING GREASES
Anon.—pp. 4-6, 29

Construction of a new Industrial Oils processing plant at Hammond, Indiana, will add new sources of glycerides and fatty acids to the industrial oil production of Swift & Company. This new construction will include units to carry out three processes, namely: solvent crystalization, solvent fractionation, and fat splitting. These processes will be combined with present facilities for refining, bleaching and hydrogenating to obtain a wide scope of industrial oil products suitable for uses in a multitude of industries. Flow charts are given for fat splitting, destearinizing decoloring.

FRICTION OXIDATION
Morton, H. T. and Patterson, F. G.—pp. 8-10, 18, 23, 26

During the late twenties and early thirties, motorists in California and the Western States replaced many anti-friction bearings in the wheels of their automobiles without complaint. Later these bearings showed failure after a few miles. This occurred during transportation in freight cars, when weight of autos rested on the wheels. The auto vibrated due to motion of freight car. Simultaneously with the automotive problems, textile customers reported early failures of bearings subjected to vibratory conditions and oscillating motion of small amplitude. In 1939, a surprise came when

(*Continued on page* 44)

OILS AND LUBRICANTS PATENT ABSTRACTS

Printed copies of patents are available from the Patent Office at twenty-five cents each. Address the Commissioner of Patents, Washington, D. C., for copies and for general information concerning patents.

From Official Gazette—Vol. 616, Nos. 1, 2, 3, 4, 5; Vol. 617, Nos. 1, 2, 3, 4.

Prepared by ANN BURCHICK

Mineral Oil Compositions Resistant to Foaming—Patent #2,452,693—Herschel G. Smith and Troy L. Cantrell, assignors to Gulf Oil Corp.

A mineral oil composition resistant to foaming comprising a major amount of a mineral oil and an amount at least sufficient to reduce the foaming tendency of said oil of a salt of (1) a salt-forming constituent selected from the class consisting of metals and an organic ammonium group derived from the class consisting of heterocyclic nitrogen bases and N-disilkarylamines and (2) the viscous liquid reaction product of heating at a temperature not exceeding 300°F. 1 mol of a glycol having from 2 to 6 carbon atoms, 1 molar equivalent of a phosphorus compound selected from the class consisting of phosphorus oxychloride and phosphorus pentoxide and 1 mol of a saturated aliphatic monohydric alcohol having from 1 to 18 carbon atoms.

Lubricating Grease—Patent #2,453,153—Arnold J. Morway and John C. Zimmer, assignors to Standard Oil Development Co.

A semi-solid to solid lubricating grease comprising lubricating oil with 5 to 20% by weight, based upon the finished composition, of acetylene black incorporated therein, the quantity of acetylene black being sufficient to impart a grease-like consistency and body to said oil.

Grinding Oil Composition — Patent #2,453,708—Everett C. Hughes and Franklin Veatch, assignors to The Standard Oil Company.

A grinding oil composition at least 90 weight per cent of which is composed of a mixture of an amount of an unrefined naturally occurring minteral oil having a viscosity of not over 100 SUS at 100°F. within the range of 53 to 78 weight per cent and an amount of an unrefined naturally occurring mineral oil having a viscosity of 2000 to 6000 SUS at 100°F. within the range of 47 to 22 weight per cent to provide a mixture having a viscosity in the range of 150 to 300 SUS at 100°F.

Grinding Oil Composition — Patent #2,453,709—Everett C. Hughes and Franklin Veatch, assignors to The Standard Oil Company.

A method of grinding which comprises grinding steel with a bonded abrasive in the presence of an oil at least 90 weight per cent of which is composed of a mixture of an amount of a mineral oil of 50 to 100 SUS at 100°F. within the range of 53 to 78 weight per cent and an amount of a mineral oil of 2000 to 6000 SUS at 100°F. within the range of 47 to 22 weight per cent to provide a mixture having a viscosity in the range of 150 to 300 SUS at 100°F.

Grinding Oil Composition — Patent #2,453,710—Everett C. Hughes and Franklin Veatch, assignors to The Standard Oil Company.

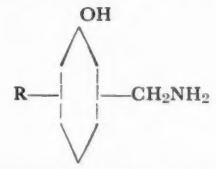
A method of grinding which comprises grinding metal with an abrasive in the presence of a grinding oil comprising at least 90 weight per cent of a base oil which is composed of a mixture of an amount of mineral oil of not over 100 SUS at 100°F. within the range of 53 to 78 weight per cent and an amount of mineral oil of 2000 to 6000 SUS at 100°F. within the range of 47 to 22 weight per cent to provide a viscosity in the range of 150 to 300 SUS at 100°F. and from 0.5 to 10% of an oil soluble phosphorus compound containing a fatty acid radical having at least ten carbon atoms.

Corrosion Preventive—Patent #2,453,833—William S. Davis, Jr., and Donald L. Wright, assignors to Standard Oil Development Co.

A rust preventing composition consisting of (1) a mineral oil base which vaporizes completely below 750°F., (2) a partially volatile corrosion inhibitor consisting of sodium petroleum sulfonates and degras in a ratio of one to two parts of degras to one part of sulfonates, the quantity of such corrosion inhibitor being so proportioned that it is sufficient to prevent corrosion but is not so great that the unvolatized residue remaining after being subjected to a temperature of 750°F. exceeds 10% by weight of the total composition, and (3) a polybutene of 60,000 to 80,000 molecular weight, the quantity of said polybutene being so proportioned as to impart to the total composition a viscosity of 350 to 1000 seconds Saybolt at 210°F.

Lubricating Compositions—Patent #2,453,850—Louis A. Mikeska and Allen R. Kittleson and Warren M. Smith, assignors to Standard Oil Development Co.

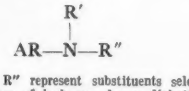
Improved lubricant composition comprising a mineral lubricating oil and a small proportion of an oil-soluble resinous auto-condensation product of an alkyl hydroxy benzyl amine having the general compositional formula



in which R represents an alkyl group of at least 4 carbon atoms.

Process for Preparing Sulfurized Lubricating Composition—Patent #2,454,034—Dayton P. Clark, Jr., assignor to Gulf Research and Development Co.

A process of preparing a sulferized oil which comprises reacting sulfur with oil in the presence of a catalyst having the general formula



wherein R' and R" represent substituents selected from the class consisting of hydrogen, lower aliphatic radicals and monocyclic aromatic radicals and AR is a benzene ring with a lower alkoxy or monocyclic aryloxy group attached to the ortho or para position.

Steam Turbine Lubricating Oils—Patent #2,454,075—Robert G. Mastin, assignor to Cities Service Oil Co.

A steam turbine oil composition comprising a refined mineral steam turbine lubricating oil having incorporated therein an antioxidant selected from the group consisting of 1-phenyl 1-3 5,5-trimethyl pyrazoline and 1-phenyl-3-isobutenyl-5,5-dimethyl pyrazoline.

Method of Resolving Petroleum Emulsions — Patent #2,454,382—John L. Harlan, assignor to Standard Oil Development Co.

A process for breaking a petroleum emulsion of the water-in-oil type which comprises subjecting the emulsion to the action of a treating agent comprising a petroleum sulphonic acid body having an amino derivative attached to the hydrocarbon nucleous thereof.

Lubricating Oil Composition—Patent #2,454,394—Eugene Lieber and Edward P. Cashman, assignors to Standard Oil Development Co.

A lubricating oil composition comprising a major proportion of waxy mineral lubricating oil containing dissolved therein a minor but pour depressing amount of about 0.1 to 5% of a condensation product having an average molecular weight above about 1000 and derived by condensation of about 200 parts by weight of aliphatic nitriles of mixed fatty acids having about 16 to 18 carbon atoms, with about 50 to 100 parts by weight of naphthalene, in the presence of about 30 parts by weight of aluminum chloride and in the presence of about ½ to 10 volumes of inert chlorinated hydrocarbon solvent per volume of mixed reactants, at a reaction temperature of about 250°F. for about 2 to 3 hours, followed by hydrolysis and removal of the catalyst and distillation of the reaction products under reduced pressure up to about 600°F. to obtain the desired condensation product as distillation residue.

Process for Breaking Petroleum Emulsions — Patent #2,454,435—Melvin De Groote and Owen H. Pettingill, assignors to Petrolite Corp.

A process for breaking emulsions of the water-in-oil type, characterized by subjecting the emulsion to the action of a demulsifying agent comprising an oxyalkylated, drastically-oxidized treated cashew nutshell liquid.

Lubricants for Textile Materials—Patent #2,454,822—Abraham Moscowitz, assignor to L. Sonneborn Sons, Inc.

A textile treating agent which comprises a hydrocarbon textile lubricating oil and substantially dissolved therein at least 28% alkali metal petroleum mahogany sulfonate obtained by reacting a petroleum mahogany sulfonate solution in an organic substantially water immiscible solvent for said sulfonate, with an oxidation agent selected from the group consisting of oxidation agents having an oxidation potential in such solution by reason of "available" O_2 and those having an oxidation potential in the solution by reason of "available" Cl_2 in amount and for a period of time sufficient to yield for its said at least 28% sulfonate solution a Saybolt viscosity at 100°F. of not in excess of 600 seconds.

Antioxidants for Mineral Oil Lubricants and Compositions Containing the Same—Patent #2,454,890—Herschel G. Smith and Troy L. Cantrell and John G. Peters, assignors to Gulf Oil Corp.

The process of preparing an addition agent for mineral oil lubricants which comprises condensing from 1 to 4 mols of benzyl benzoate, 1 to 6 mols of N-dimethylaniline and 0.5 to 6 mols of formaldehyde per mol of benzyl benzoate in the presence of an activated clay catalyst at a temperature not in excess of 350°F., and recovering the condensation product.

Process of Treating Glyceride Oils With Activated Magnesium Oxide — Patent #2,454,937 — Wendell W. Moyer and Ralph A. Marmor assignors to A. E. Staley Mfg. Co.

The process of treating glyceride oil, which comprises mixing said oil with activated magnesium oxide prepared by heating hydrated magnesium oxide for about three hours at a temperature lying within the range of about 350°C. to about 500°C. to stabilize the oil against reversion characteristics, and thereafter separating said oil from said magnesium oxide.

Addition Agent for Lubricants—Patent #2,455,337—William A. Jones, assignor to Continental Oil Co.

A lubricating composition comprising a major proportion of an oil of lubricating viscosity and from about .01% to 10% of the product produced by contacting with a solid adsorbent a petroleum oil substantially free of naphthenes and napthenic acids, having a SSU viscosity within the range of about 50 seconds at 100° to about 200 seconds at 210°F. and a viscosity index of not less than 80, washing the adsorbent material with naphtha, dissolving from the adsorbent material the resinous material deposited thereon which is soluble in chloroform, and esterifying such recovered resinous material with an organic hydroxy compound selected from the class consisting of alcohol and phenol.

Solidified Oils and Methods of Manufacture — Patent #2,455,649—Alan Beerbower and Harold A. Ricards, assignors to Standard Oil Development Company.

A stabilized, solidified mineral oil consisting essentially of a mineral oil gelled by a soap formed in situ from free saturated fatty acids, and stabilized by the saponification in situ of a fatty oil rich in esters selected from the group consisting of esters of saturated fatty acids and esters of hydroxylated unsaturated acids, said fatty oil being added to the initial mixture in the proportion of ⅓ to ⅔ of the said free saturated fatty acids.

Oily Composition — Patent #2,455,659 — Gordon W. Duncan and John C. Zimmer, assignors to Standard Oil Development Co.

A composition suitable for use as a soluble cutting oil, or the like, consisting essentially of about 84% mineral base lubricating oil, about 8% sodium petroleum sulfonate, about 2.5% sodium nitrite, about 2.5% naphthenic acid, 0.4% caustic soda, 0.9% isopropyl alcohol, 0.05% wax, and a small amount of water, said proportions being by weight.

Mineral Oil Composition — Patent #2,455,668—Everett W. Fuller and Henry S. Angel, assignors to Socony-Vacuum Oil Co., Inc.

A mineral oil composition normally susceptible to the formation of haze therein, comprising a viscous mineral oil fraction containing a minor proportion, sufficient to stabilize said oil fraction against the deleterious effects of oxidation, of a phosphorus- and sulfur-containing reaction produce obtained by reaction, at a temperature of from about 100°C. to about 190°C., of a phosphorus sulfide and a material selected from the group consisting of a dicyclic terpene and an essential oil predominantly comprised of a dicyclic terpene, and having in combination therewith a minor proportion, sufficient to suppress the formation of haze therein, of a wax-substituted hydroxyaromatic ester of an organic carboxylic acid.

Deodorizing Petroleum Oils and Waxes — Patent #2,455,670—Francis M. Graves, assignor to Socony-Vacuum Oil Co., Inc.

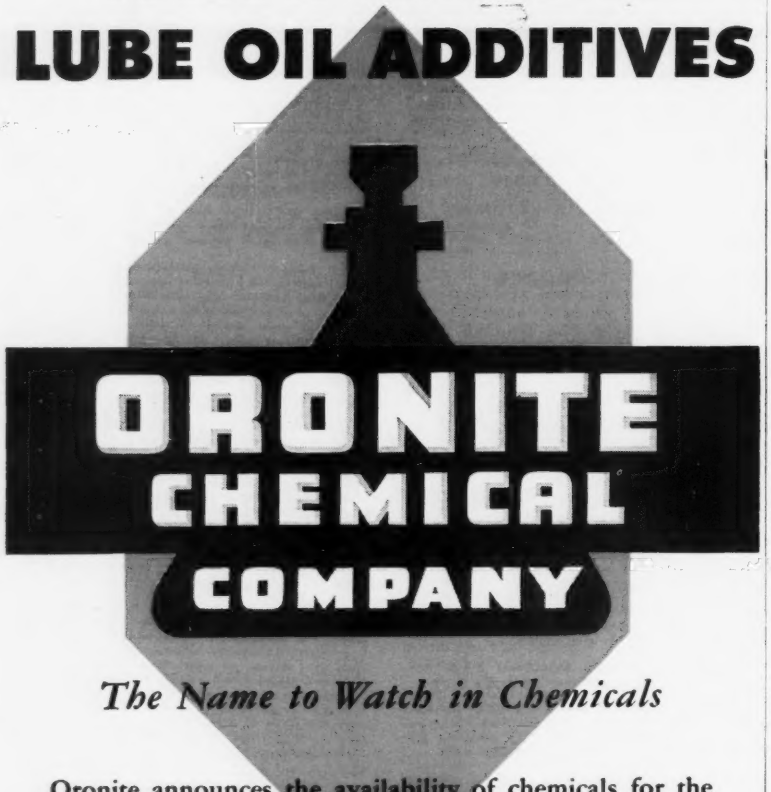
A process for producing a substantially moisture-free, odorless petroleum wax, comprising maintaining a moisture-containing petroleum wax at a temperature above its melting point but not in excess of 40°F. thereof, blowing said molten wax with air until substantially free of moisture, introducing into said molten wax a small amount of ammonia sufficient to remove the rancid odor developed as a result of the aforesaid air-blowing, and removing excess ammonia from said wax to yield a substantially dry, odorless petroleum wax.

Distillation of Acid-Treated Oils—Patent #2,455,679—Minor C. K. Jones and Edward C. Eulhardt, assignors to Standard Oil Development Co.

The process of distilling an acid-treated mineral oil which comprises adding 90-95% of the stoichiometric quantity of caustic alkali necessary to neutralize any acid reacting substance evolved from any residue of the treating acid during the distillation of the oil together with a sufficient amount of a naphthenic acid soap to be capable of completing said neutralization, and carrying out the distillation in the presence of the said caustic alkali and the naphthenic acid soap.

(*Continued on page* 43)

A New Name in LUBE OIL ADDITIVES



The Name to Watch in Chemicals

Oronite announces the availability of chemicals for the compounding of lubricating oils. These are available as complete balanced additives, ready for blending into suitable base stocks and as components for specific purposes.

The outstanding performance of Oronite additives in today's special lubricants is your insurance of high quality and dependability.

Oronite is prepared to make special chemicals for addition to lubricating oils and for other uses on a custom basis. Inquiries are solicited.

ORONITE CHEMICAL COMPANY

38 Sansome St., San Francisco 4, California • 30 Rockefeller Plaza, New York 20, N.Y.
Standard Oil Bldg., Los Angeles 15, California • 600 So. Michigan Ave., Chicago 5, Illinois
824 Whitney Bldg., New Orleans 12, Louisiana

In 1781, the present city of Los Angeles was established by the Royal Decree of Governor Felipe de Neve. In its 150 years of growth and development, it has become famous as the tourist's winter and summer resort, and the motion picture capital of the world. It is a city noted for its fine homes and a diversified industry, which has placed Los Angeles among the top-ranking cities of the United States.

A.S.L.E. is represented in the city of L. A. by one of our finest and most active sections.

TOOL ENGINEERS TO MEET

Seventeenth Annual Meeting of the American Society of Tool Engineers will be held March 10, 11 and 12, in Pittsburgh, according to an announcement by Irwin F. Holland, President of the Society.

At this meeting, tool engineers from throughout this country and Canada will gather in the Hotel William Penn for a series of technical sessions on new developments and problems in the tool engineering and related fields. Tours of plants in the Pittsburgh area, always a major feature of ASTE National Meetings, will offer a unique opportunity to view operations in a wide variety of industries.

For further information write Jno. M. Cannon Associates, Inc., Counsel on Industrial & Public Relations, 523 Penobscot Building, Detroit 26.

PRODUCTION SHOW

Plans are already well under way for the 1949 Chicago Technical Conference and Production Show at the Hotel Stevens on March 14 to 17.

The conference, over the four day period, will be broken up into 17 sessions with a maximum of three sessions at any one time. Approximately 50 nationally known speakers will bring their latest thinking and experience to the many subjects to be considered by the conference. Details of this program are being worked out so that the subjects will be of interest to the supervisory personnel of industry as well as to the members of the 55 affiliated societies.

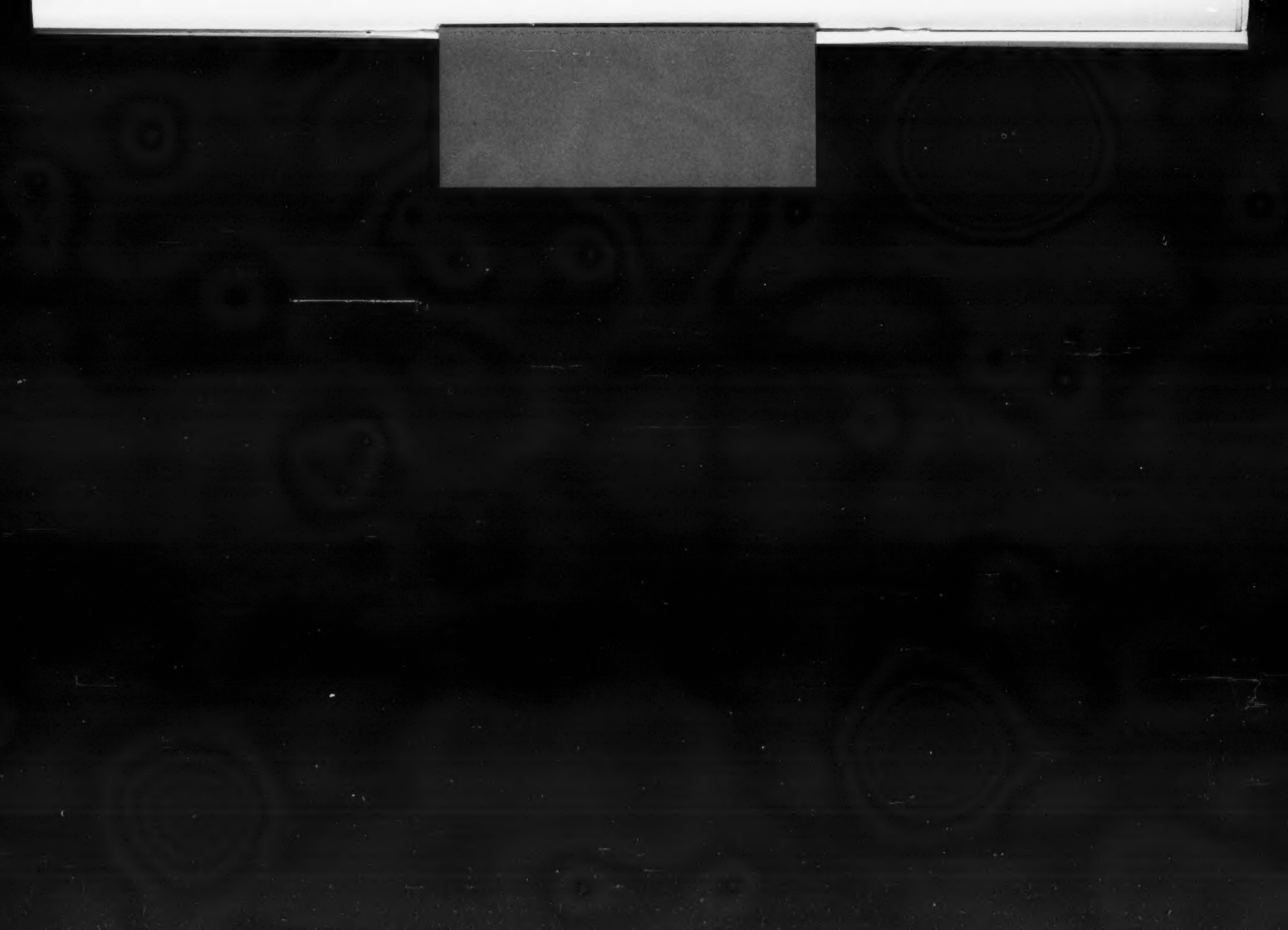
The banquet on Wednesday evening, March 16, will be one of the highlights of the conference and show. One of America's outstanding industrialists will be the principal speaker, and an unusually fine entertainment program will run through the dinner and after the main address. This year the show will shut down for the banquet in order to give the exhibitors an opportunity to attend.

The show will run four days this year and will be open as follows:
March 14—Noon—10:00 p.m.
March 15—Noon—10:00 p.m.
March 16—10:00 a.m.—5:00 p.m.
March 17— 9:00 a.m.—5:00 p.m.

The production show will parallel the interests of the conference. Exhibitors will show the latest in equipment, materials, methods and services that will help maintain American world-wide industrial supremacy.

No registration fee of any kind will be required for the production show. All that they will need to do is to fill out a simple form giving their company connection and type of work in order to be admitted. Members of all societies affiliated with the Council will want to see the show and are especially invited.

Present plans for the conference call for a nominal registration fee of $1.00 for the four day session, provided registration is made prior to March 10. At the conference the registration fee will be $2.00 for the four days, or $1.00 per day for single days.



NEW PRODUCTS and EQUIPMENT

OIL PURIFIER

The world's largest multiple refill-type oil purifier, employing seven filtering units, is in current production at Honan-Crane Corporation, a subsidiary of Houdaille-Hershey, Lebanon, Indiana.

Originally developed for large volume users of rolling oils in the aluminum industry, these "king-size" purifiers are specified for both domestic and foreign installations. Other applications in industry, requiring large volume oil purification when floor space is at a premium, are adequately provided for by the big unit.

The maximum capacity of this unit exceeds 2100 GPH of 50 seconds viscosity color clear oil on continuous circulation. It therefore provides the highest flow rate consistent with maintaining clarity and low neutralization number of the oil.

Due to the high flow characteristics, the giant Honan-Crane purifier has a greater purification capacity than seven smaller purifiers containing an equal amount of Cranite, and operated in parallel. However, the big unit is much more compact than the seven individual units, being four feet in diameter and six feet high.

Detailed specifications on the new large-size Honan-Crane purifier may be obtained from Honan-Crane Corporation, 818 Wabash Avenue, Lebanon, Indiana.

NEW SILICONE BOOKLET

DC 200 Fluids . . . Silicone Notebook, Fluid Series No. 3, published and available from Dow Corning Corporation, Midland, Michigan.

Basic properties and industrial uses for this continuous series of remarkably stable, semi-inorganic silicone fluids are given in this comprehensive booklet. Available in viscosity grades ranging from 0.65 to 1,000,000 centistokes, DC 200 Fluids have many of the properties that are desirable in a lubricant. They are stable to temperatures up to 400 F; minimum flash points range up to 600 F; freezing points range from —47 to —123 F. They are exceptionally resistant to oxidation and have remarkably flat viscosity-temperature slopes.

Between —15 F and 250 F, for example, the viscosity of an SAE 30 oil increases more than 50 times as much as a DC 200 Fluid having the same room temperature viscosity. DC 200 Fluids also show exceptional resistance to shear break-down. The viscosity of a DC 200 Fluid decreased only from 71 to 70 centistokes after 500 hours at 140 F in an hydraulic system operating at 1500 psi. Under the same conditions, a comparable petroleum hydraulic oil lost 50% of its original viscosity after only 100 hours.

Tests indicate that between certain metal combinations these silicone fluids have lubricating properties comparable to those of the best non-additive petroleum oils at room temperature, and superior at temperatures above 200 F. They are good lubricants for plain or chrome plated steel against aluminum, copper, brass or tin base babbit. They are inferior lubricants for steel on steel or cast iron. They are excellent lubricants for rubber bearings and plastic or fiber gears and bearings.

These silicone fluids are useful as damping and hydraulic media, liquid dielectrics, lubricants, release agents, coatings, impregnants and additives. Among the properties covered in this 36-page publication are dielectric properties, chemical behavior, solubility, surface tension, specific heat, thermal conductivity, effect of temperature on volume, compressibility, light and sound transmission, and physiological characteristics.

NEW LUBRICANT APPLICATOR

A new handy gun type applicator for blowing "Grafize," a clean, dry powder lubricant, into working mechanisms has been made available by this company.

It is very easy and simple to use. Just remove the nozzle, compress bulb, insert it into the can, release pressure and "Grafize" is drawn into the gun. A slight pressure ejects the powder to the desired spot. Instant refillable feature. Designed for instant and direct application of "Grafize."

"Grafize" is a lubricant in powder form, developed through extensive research and tests, that is ideal for lubrication of delicate instruments where oils and greases are not applicable or desirable.

"Grafize" is not an oil and has no oil derivatives. Unlike oil, it is said to withstand heat up to 6300 degrees.

"Grafize" can be added to oils or greases and will increase the quality of lubrication and length of lubricating life.

In the Die Casting industry it is now used as an addition to fuel oil for lubrication on slides or ejection mechanisms. It is reported that clean castings or better quality are produced. The acid bath necessary when black graphite is used is eliminated.

Test samples are available from the manufacturer, Reardon Products, 2105 S. Adam Street, Peoria 2, Illinois.

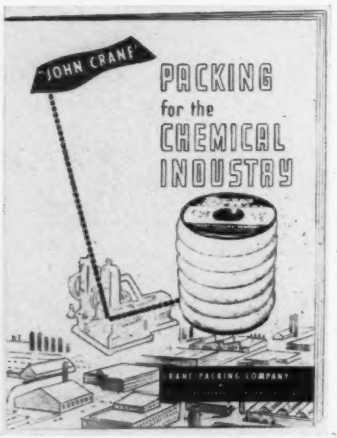
NEW INDUSTRIAL OIL UNIT

Operations have begun in the new Industrial Oil processing unit of Swift & Company's Technical Products Plant at Hammond, Indiana. First delivery of product was made to Lever Brothers Company, also in Hammond.

The new plant is located on part of a 70-acre tract which is being set aside by the company for further development of technical products facilities.

Products from the plant will provide raw materials to industries that manufacture such items as cosmetics and toilet creams, soaps, floor waxes and polish, linoleum, phonograph records, candles, shoe polish, rubber products, paint, textiles, wallpaper, printing inks, cleaning and waterproofing agents, leather dressing, buffing and lubricating compounds, insecticides and cutting oil.

Research into new and improved products is to be carried on in an experimental pilot plant as well as in Swift & Company's central research laboratories.



NEW CRANE BOOKLET

A booklet entitled "Packing for the Chemical Industry" has been prepared by the Crane Packing Company of Chicago. It is designed to give a complete picture of packing requirements for practically all chemical applications. Each "John Crane" style is fully explained and illustrated, and recommendations are made for specific services and temperatures.

A copy may be obtained by writing to the manufacturer. Address Crane Packing Company, 1800 Cuyler Avenue, Chicago 13, Illinois.

CLEAN OIL BOOKLET

The new issue of "Clean Oil," telling how one firm saved more than $30,000 using a central coolant clarification system, is being distributed to more than 12,000 industrial engineers by Honan-Crane Corporation, Lebanon, Indiana, a subsidiary of Houdaille-Hershey Corporation.

Case histories, reported in Volume 4, No. 2 of the Honan-Crane quarterly publication, tell of savings in industrial, marine and power installations of Honan-Crane equipment.

There is also an engineering report on applications of the Houdaille Conveyor in the metal working industry. The conveyor, known to materials handling engineers as the automatic materials transport, collects and transports any type of solid or fibrous material that will settle to the bottom of a tank.

Write on your company letterhead for a copy of the new issue of "Clean Oil" today. Address Honan-Crane Corporation, 818 Wabash Avenue, Lebanon, Indiana.

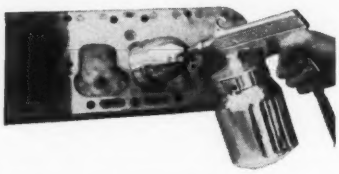
ALEMITE CATALOGUE

A 48-page rotogravure catalogue presenting Alemite's full line of industrial lubrication equipment is now available to industry through Alemite distributors and jobbers, Gus Treffeisen, distributor salesmanager of the Alemite division of Stewart-Warner Corporation, has announced.

A highlight of the catalogue is the Alemite "barrel-to-bearing" selection guide. The pictorialized presentation of the guide makes it easy for purchasing agents and buyers to select correct lubricants and equipment for every plant need and helps reduce production costs, Treffeisen said.

ENPRO BLAST GUN

Enpro Combination Blast Gun, manufactured by Engineered Products, Inc., 1224 Speer Boulevard, Denver, Colorado, is a versatile adaption of sand blasting and solvent spraying. The Enpro Gun improves and simplifies surfacing, production, cleaning and finishing in automotive and industrial fields. Air operated, portable and efficient, Enpro leaves no buffing marks, no grooves or ridges, no scuffed, gouged or uneven surfaces. The Enpro Gun has no shafts to break, no wheels to dress and no motors to burn out.



Enpro is particularly useful in reaching inaccessible places such as wheels, drip mouldings, grill work, brick and rough finished walls, rungs, spoolings, steam radiators, fins, odd shapes, corners, crevices, and close fittings.

The Enpro Blast Gun is connected to any air line and is equipped for sand blast operations or spraying solvents and liquids. The nozzle is easily changed by loosening a retaining nut and slipping another nozzle in place.

Two attachments are supplied with the Enpro Gun; an "Abrading" case-hardened nozzle for use in "blast" operations and a "Solvent" nozzle for use with oils or chemicals. The abrading nozzle incorporates a "safety" tip that shows wear when barrel needs replacement.

Enpro is equipped with a 3 pint container designed for quick, sure locking with a quarter turn. The turbulence shield is designed to stop and retain the bulk of spent abrasive that ricochets from surface being worked.

(Continued on page 35)

BOOK REVIEWS

Machine Design

By Paul H. Black (Professor of Machine Design, Cornell University).

McGraw Hill Book Company, New York, New York, 1948, 357 pages. Price $4.00.

The aim of this book, as stated by the author, is "to serve as a textbook for courses in general Machine Design and as a reference book in Mechanical Design offices."

The book starts with a review of materials of processes, an analysis of design computation and the factors entering into stress loading. Following this, many of the topics which usually appear in Machine Design books are discussed. The diagrams are well done and the author writes in a clear and lucid style.

An interesting chapter appears in the book covering surface finish, friction and wear which, in turn, is followed by a chapter on sliding bearings and lubrication. Both of these chapters are well done.

The final chapter in the book covers some aspects of vibration and vibration control. A group of well chosen problems covering various aspects of the field appears at the end of the book.

Combustion Engines

By Arthur P. Fraas (Associate in Motors — Aeronautical Institute of Technology of Brazil).

McGraw Hill Book Company, Inc., New York, New York, 1948. 439 pages. Price $5.50.

This book is designed as a text for engineering college seniors and engineers in industry. The book develops from fundamental principles to practical applied engineering problems. The major emphasis is on the reciprocating type engine and covers automotive, airplane and diesel engines.

Fuels and lubricants are discussed to some extent in one of the chapters, and an additional chapter covering lubrication alone gives a good presentation of fundamental principles.

One chapter is devoted to gas turbines. The text includes problems for solution and a group of combustion charts are supplied with the text in a separate envelope.

Mathematics at Work

By Holbrook L. Horton.

Industrial Press, 148 Lafayette St., New York 13, N. Y. 728 pages. Price $6.00.

This book is a working manual intended for machine designers, tool engineers, gage designers, mechanical draftsmen, technical or trade school students, and teachers. The practical applications of arithmetic, algebra, geometry, trigonometry, and logarithms are illustrated by a wide variety of mechanical problems taken from actual practice. These problems are analyzed and solved in an easy-to-follow, step-by-step procedure.

The classification of problems is such that problems illustrating some common mathematical principle or method have been grouped together. This classification makes it easy to find the general type of problem at hand or one closely paralleling it, hence it is possible to apply the manual to a much broader range of problems than might be at first apparent.

A reference section consisting of five chapters provides a concise but clear review of the practical fundamentals of arithmetic, algebra, geometry, trigonometry, and logarithms, so that where basic principles or formulas are used in the problem solutions they can be immediately referred to, if necessary.

To round out the book as a complete working manual, 145 pages of standard mathematical tables, including logarithmic and trigonometric tables, are included.

High-Polymer Physics—A symposium

Edited by Howard A. Robinson.

Published under the auspices of the American Institute of Physics, Remsen Press Division.

Chemical Publishing Company, Inc., Brooklyn, New York, 1948. 572 pages.

Thirty-nine prominent physicists and chemists have contributed to this symposium on the relatively new subject of High-Polymer Physics. Important research laboratory results are given and discussed. Both the physicist and the chemist are required to explain the complex phenomena encountered with High-Polymers.

Individual articles are devoted to molecular structure, physical and physico-chemical properties of natural and synthetic High-Polymers. In the class of High-Polymers are included plastics, synthetic resins, textiles, rubber, and many other common materials.

The text is supplemented with numerous tables and illustrations, and the discussions range from detailed discussions of physical properties to such complex subjects as thermal diffusion of polymer solutions.

NEW PRODUCTS AND EQUIPMENT

(*Continued from page* 34)

HOUDAILLE CONVEYOR

Elimination of manual labor in the bulk transporting of solid or fibrous material of a loose nature is one of the principal advantages of the Houdaille Conveyor, according to materials handling engineers.

A continuous, automatic materials transport, the Conveyor will move any material which will settle to the bottom of a tank, hopper, bin or other form of reservoir. If the material has settling qualities, the Houdaille system can be adapted to any transporting problem of either production materials or waste products.

The conveyor consists of a series of neoprene or cast iron flights, assembled on an endless chain. The chain and flights are pulled through a pipe casing by means of a high torque gear transmission. The casing custom-bent to the specifications of the origin and delivey points is of 2, 4 or 6 inch diameter (other sizes are available when needed) depending on the capacity requirements of the particular installation.

Many different applications of the conveyor have already been developed by Honan-Crane engineers. In the metal-working field, the conveyor moves metal chips, cast iron dust, aluminum oxide and abrasive sludge, all waste products.

If you now have a transportation problem in handling wet or dry, solid or fibrous material, write to Honan-Crane Corporation, 818 Wabash Avenue, Lebanon, Indiana, for more information without obligation.

NEWS OF THE SECTIONS

DAYTON

The regular meeting was held on November 23rd at the Engineers' Club. The speaker was Mr. L. A. Danse, General Motors Corporation, Detroit, and a Director of A.S.L.E.

Mr. Danse gave a very interesting talk on the subject, "The Benefits of a Planned Lubrication System." He used as a highlight of his talk "Oil is Cheaper than Machinery." Further the proper application of oil and grease requires analyzing the specific problem. To do this it is necessary to get the interested people together and have a common understanding on objectives. Usually those interested would be Master Mechanics, Maintenance Superintendents, and Foremen of Oil Houses. In fact, the responsibility goes right down to the man who oils the machinery.

Generally, too much is taken for granted as to cost of down time due to improper lubrication. He pointed out that in one case the Time Study Dept. helped in actually determining that the down time due to improper lubrication was 17 to 18%, whereas, it had been previously estimated that the figure was 8 to 10%.

It was his feeling that a Shop Lubrication Committee should act in an advisory capacity. Further, every company using Industrial Lubricants should have a Lubrication Engineer either on a full or part time basis, depending on the size of the plant.

The efforts of these interested people should be:—

1. Get facts; not opinions.
2. Reduce wherever possible the total number of oils and greases in a plant.
3. Make sure that present equipment has proper automatic lubricating devices as the greatest fault has been in applying large amount of lubricants infrequently; whereas, a little lubricant applied more often would have lowered maintenance costs.
4. Insist on new machinery having automatic lubrication systems, which insure proper lubrication the moment the unit is put in operation.

The Dayton Section wishes to thank Mr. Danse for his very fine presentation, which clearly reveals the need of A.S.L.E. in Modern Industry.

And we thank Mr. H. L. Sellers, Secretary of the Dayton Section, for his able comments on Mr. Danse's paper. Frankly we didn't even use our editorial powers, but are publishing it verbatim. Congratulations, Mr. Sellers.

PHILADELPHIA

The January 20th dinner meeting was held at the Broadwood Hotel, and devoted to membership promotion. Distinguished guests from engineering schools in the vicinity as well as many outstanding executives from industry were invited. Several of our national officers were present, and we only regret that we had to go to press before we could report full details as to those present and the results of the meeting. However, we are sure it was an outstanding success and will be a tremendous boost to an increase in our membership.

LOS ANGELES

The December 7th meeting was held at the Ethyl Corporation. Subject: "Silicones as Special Purpose Lubricants" by Mr. Robert B. Stewart, Technical Representative , Dow Corning Corp., Western Office. Mr. Stewart traced the history of the development of silicones, discussing their general properties and specific characteristics and uses. Samples of the various silicone products were on hand for examination. The subject of this new industrial material has had wide discussion, and the opportunity to hear more of the pertinent details was welcomed by the entire membership.

ST. LOUIS

The St. Louis section reports that at the regular meeting Mr. W. King Simpson, Lubrication Engineer for Electro-Motive Division, General Motors Corporation, spoke on "Lubrication of Diesel Engines in Railroad Service." The meeting was featured as "Railroad Night," and the guests included representatives from five different railroads who are using Diesel power. Mr. Simpson discussed the advantages of using additive oils in railroad power, and stated that approximately forty-two railroads in the United States are now using these oils in their engines. The representatives of several oil companies joined the railroad men in a lively discussion of the subject following the delivery of the paper.

BOSTON

The third technical meeting of the Boston section was held at the Sheraton Hotel on the night of January 10, 1949. The subject for discussion was "Textile Lubrication," which was very ably handled by Mr. J. R. Crotty of the Crompton & Knowles Manufacturing Co. Mr. Crotty brought out facts and figures on the past experience of his company in matters affecting proper lubricants and their application. The discussion was handled by Mr. R. J. McConnell of Whitin Machine Works. The meeting was well attended, there being approximately 100 members and guests, several coming from Maine. An interesting part of the meeting was provided by Mr. Frisbie of the E. F. Houghton Co., who presented Chairman Baker with a handsome gavel, suitably inscribed. Your National Secretary was also present at this meeting and it was encouraging to see the spirit of growth and accomplishment evidenced in our new England Sections.

MILWAUKEE

The regular dinner meeting was held on Monday, January 17, 1949, at 6:30 P. M. The subject of the meeting was "Fuels for Internal Combustion Engines," by Mr. Royce Childs, Head of Fuel Research Engine Laboratory, Waukesha Motors Company. The subject of the February meeting is "Corrosion Prevention," by Mr. Robert Clendenin, Nox-Rust Chemical Corp.

(*Continued on page* 38)

A.S.L.E. Section Officers

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Members shall be: (1) persons not less than twenty-four years in age who are engaged in research and instruction at technical schools, universities and various publicly and privately supported institutions in the field of lubrication; or (2) persons not less than twenty-four years in age who have occupied recognized positions as Lubrication Engineers for a period of three or more (not necessarily consecutive) years prior to date of admission, involving the responsibility for or supervision of the development, selection, field use and application of lubricants as differentiated from other activities; or (3) persons not less than twenty-four years in age who are indirectly concerned with the field of lubrication, but possessing other qualifications of experience, knowledge and accomplishment, have manifested a particular interest in the purposes and welfare of the Society, to the extent that their membership would be a valuable contribution to the successful functioning of its activities.

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*Denotes Residence Address Preferred.

A. S. L. E. PERSONALS

Gits Bros. Mfg. Co. of Chicago, well-known manufacturing firm of lubricating devices and shaft seals, announce the opening of a Michigan branch office and have appointed Mr. Frank A. Kovarik, General Sales Manager. He will establish and manage the branch, located in Ludington, where operations will be supervised for the entire state. The decision for the Michigan office has been prompted by the very wide use of the company's products in that state. A well known figure in the lubricating equipment field, Mr. Kovarik has been responsible for many of his company's achievements in the industry. He will concentrate on service in seal engineering, particularly applications of the new shaft seals recently announced by the Gits firm.

Mr. Robert W. Carr wishes to inform his many friends in the industry that he is now Special Products Manager for the San Francisco Division of the Shell Oil Company.

Mr. Dudley C. Jackson, former Service Manager for the Trabon Engineering Corp., and a very active and hard working member of the Cleveland-Youngstown Section, of the A. S. L. E., has recently acquired the distributorship of Trabon equipment for the Chicago Metropolitan area. While this is a loss to the Cleveland-Youngstown Section, it is a decided gain for the Chicago group.

NEWS OF THE SECTIONS

(*Continued from page* 36)

BUFFALO

The regular dinner meeting was held on Thursday, January 20, 1949, at 6:30 P. M., Westbrook Hotel, Delaware Ave. The subject of the meeting was *"The Lubarometer."* This important instrument, valuable in measuring the thickness and effectiveness of OIL FILMS was too big to carry in for a demonstration. Theodore Whittleton, of Alox Corporation in Niagara Falls, New York, had some very clever slides demonstrating its operation and sensitivity, which he presented and discussed.

TWIN CITIES

The regular dinner meeting was held on Thursday, January 13, 1949 at 6:00 P. M., Jax Cafe, Minneapolis, Minn. The subject of the meeting was "Recent Advancement in the Development of Winter Oils," by Mr. Vern Scott, Manager of Lubricating Oil Dept., W. H. Barber Co. As an extra added attraction was shown, through the courtesy of the Standard Oil Co. of Indiana, a new animated film, "Gasolines Amazing Molecules," graphically depicting how today's gasolines are made and how they operate in your car.

PITTSBURGH

The regular dinner meeting was held on Friday, January 21, 1949, at 6:30 P. M., Sheraton Hotel, Blvd. Allies & Wood St. SUBJECT: "Laboratory Evaluation of Gear Oils," by Dr. E. M. Kipp, Aluminum Co. of America. (See section officers listing for new officers.)

FT. WAYNE

Mr. W. P. Youngclaus of the Alemite Div., Stewart Warner Co., spoke at the regular meeting of the Ft. Wayne section, held December 9, at the Van Orman Hotel. His subject, "Lubrication Engineering Becomes of Age," described in detail the progress that had been made in the field of lubricants and their application. Further meetings of the Society will be held on the second Thursday of each month.

PROVIDENCE

The meeting of the Providence section was held on the evening of January 6, 1949, at the Providence Engineering Building. Mr. L. A. Danse, Supervisor, Materials and Processes, Production Engineering Section of General Motors Corporation of Detroit, was the speaker of the evening. Actual case histories showing savings in operations at General Motors plants were discussed, and the benefits of a planned lubrication program were brought out. National secretary Mr. W. F. Leonard gave a short talk on the progress of the Society.

Silicone News

DC SILICONES

IN BLIZZARD OR HEAT-WAVE . . .

Fortunately for men and machinery, blizzards come in season. We have time to prepare for them with heavier clothes and thinner lubricants. But it is not practical to change lubricants in aircraft that take off in tropical heat and fly into sub-zero weather, or in the parking meters that line the main streets of cities and hamlets from the Yukon to the Rio Grande.

Photo Courtesy Mi-Co Meter Division, Michaels Art Bronze Co.

Dow Corning Silicone Oil, DC 550R lubricates 8 moving parts and enables Mi-Co parking meters to give trouble-free service the year around.

The problem in such cases is to find a lubricant which does not run out when hot, thicken when cold, or gum up with age. That's why many manufacturers like the Mi-Co Meter Division of the Michaels Art Bronze Co. Inc., of Covington, Kentucky, are using DC Silicone Oils or Greases.

Mi-Co Meter required a lubricant that would not thicken or thin out enough to alter the performance of parking meters exposed to temperatures ranging from −40° to 150° F. Field testing under the sun of California and in the blizzards of Fairbanks, Alaska proved that one of our silicone oils, DC 550R, was superior to any other lubricant tested. Now all Mi-Co Meters are factory lubricated with DC 550R.

Dow Corning Silicone Oils and Greases are used in a wide variety of applications from automatic toaster timers to 6 inch roller bearings exposed to temperatures up to 700° F. If your lubrication problems involve high or low temperatures, weathering, or a combination of all three, phone our nearest branch office or write for data sheet C5-9P on DC Silicone Oils or data sheet D1-P on DC Silicone Greases.

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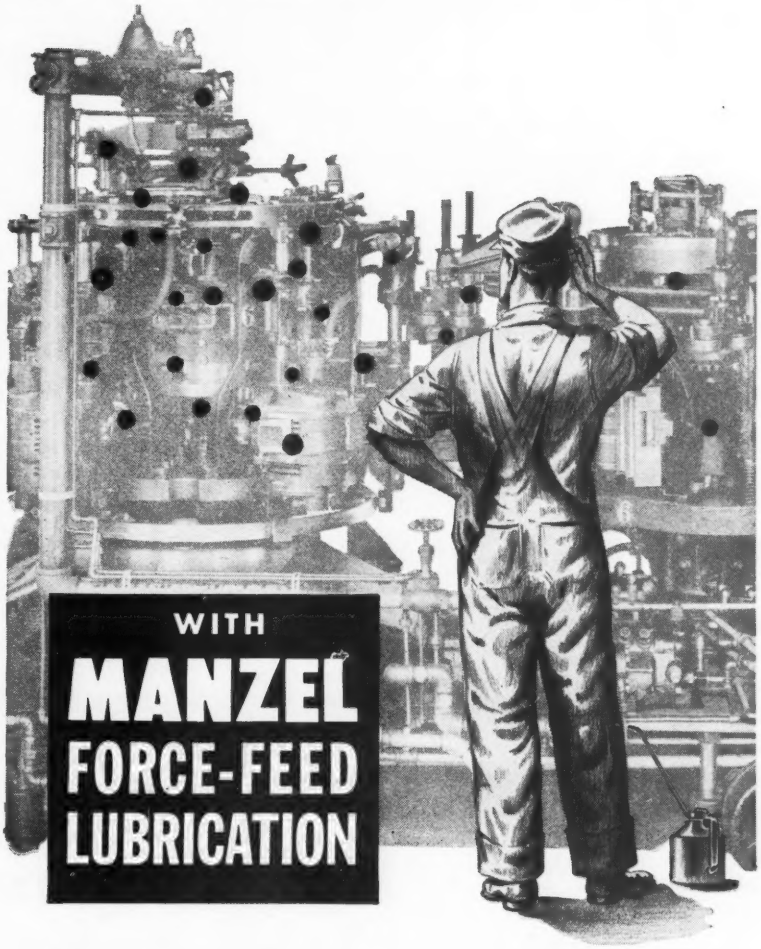
FIRST IN SILICONES

CORRECT THESE SPOTS BEFORE HIS EYES!



MANY spots requiring many different amounts of lubricant make it easy for a new man (or even an experienced one) to get all mixed up.

Manzel Force Feed Lubricators eliminate not only the confusion—but also the workman. For Manzels automatically lubricate any number of wearing points—no matter how hard to get at. Just enough of the right type of lubricant is always at each point.

Manzel Force Feed Lubricators save the initial cost many times over each year. They are supplied as standard equipment on various makes of engines, pumps, compressors, and other heavy machinery. Or they can be installed on your present equipment.

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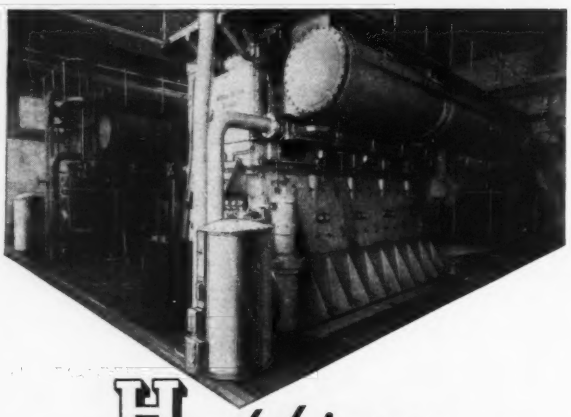

Hutchinson gets DEPENDABLE OIL PURIFICATION

ON ALL SIX DIESELS at the Municipal Light & Power Plant, Hutchinson, Minnesota, Honan-Crane equipment delivers dependable oil purification.

Superintendent R. E. Young uses Honan-Crane purifiers on three 625 hp McIntosh-Seymours, two 3060 hp Busch-Sulzers, and one 1500 hp Nordberg, and maintains a fine record of continuous engine performance.

Let Honan-Crane engineers tell you about full purification of diesel fuel and lube oils at low cost. Write to Honan-Crane Corp., a subsidiary of Houdaille-Hershey Corp., at Lebanon, Ind.

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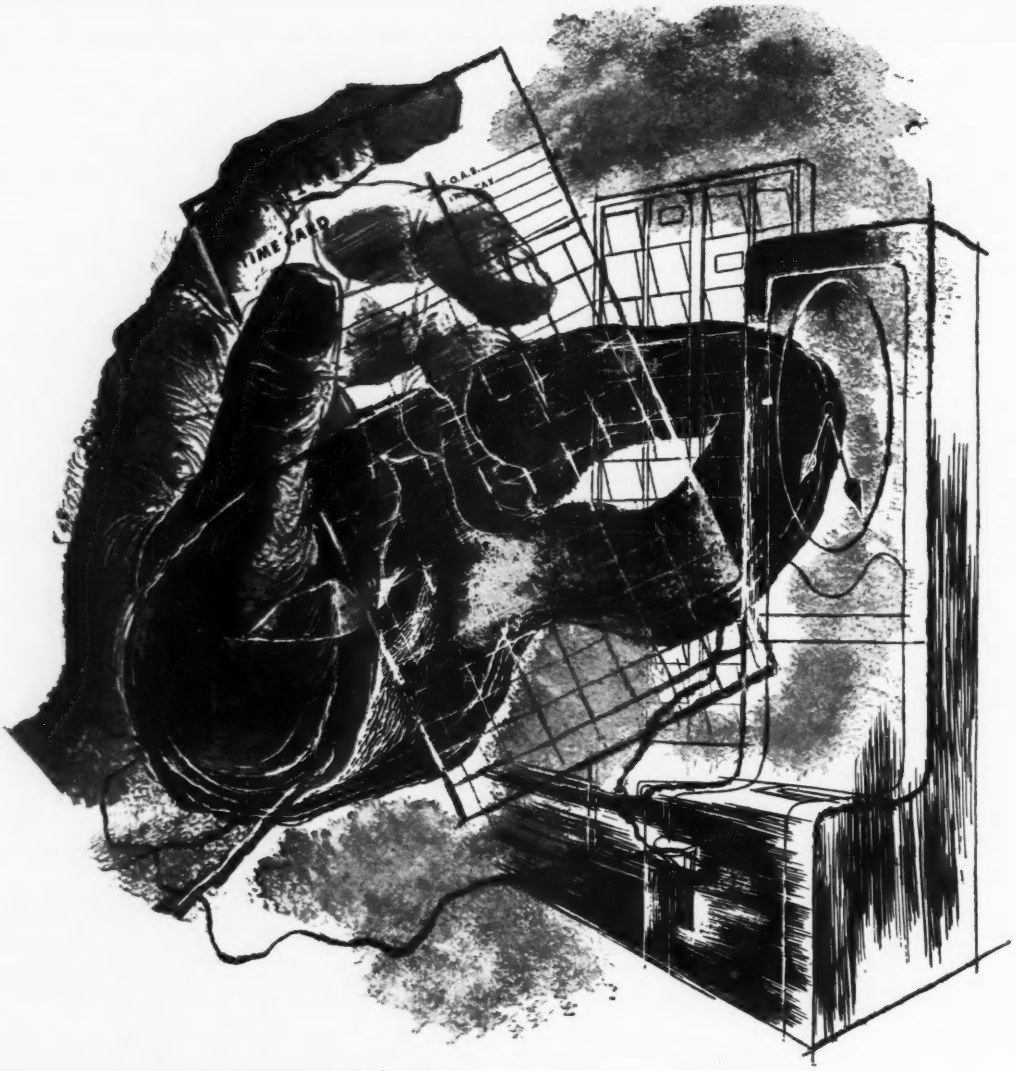
Yes, the Algerie and five sister ships have the compact and dependable oil purification system that is right for marine use —Honan-Crane. Easily serviced in low headroom quarters, 18 inch clearance is needed for the double-deck filter refills.

For full information on low cost purification of diesel fuel and lube oils, write to Honan-Crane Corp., 818 Wabash Ave., Lebanon, Indiana, a subsidiary of Houdaille-Hershey Corp.



Is this PROFIT THIEF on your payroll?

He's a slick operator. He's at work on machines in plants all over the country retarding production, eating away at profits, costing industry enormous amounts that *can* be saved!

Not in *your* plant, you say? Why not have a look? Today!

Are you still scooping grease from drums to guns with antiquated paddles? There's your profit thief at work—wasting time, wasting grease, risking dirt and contamination.

You can save 3¾ man hours for every 100 lbs. of grease.

Are you lubricating machines by hand—the old, time-wasting, risky, hit-or-miss method?

You can save up to 23.9 man hours in *applying* each 100 lbs. of grease.

Are you paying the price of "down-time" and lost precision for lack of the right grease at the right time?

You can make lubrication foolproof—make sure every bearing gets the right grease in measured amounts every time—even lubricate hundreds of bearings from one central point—while machines continue to produce.

How about it? Is this profit thief loose in *your* plant—on *your* payroll?

His label is "faulty, old-time, costly lubrication methods." Methods that are adding staggering sums to the already high cost of production.

There's one proven way to stop this loss.

An Alemite representative can tell you in 10 minutes how Alemite Methods will simplify and better organize your lubrication procedures. He can show you how mechanized lubrication from barrel-to-bearing will increase your production and profits.

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ALEMITE

MODERN LUBRICATION METHODS
THAT CUT PRODUCTION COSTS

Another Product of STEWART WARNER

OILS AND LUBRICANTS PATENT ABSTRACTS

(*Continued from page* 31)

Production of Oil-In-Water Emulsions—Patent #2,455,820—Arnold B. Steiner, assignor to Kelco Company.

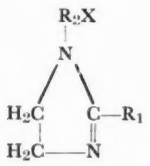
The method of making a stable, oil-in-water emulsion which comprises: intimately dispersing an oily substance in an aqueous liquid containing a glycol alginate.

Lubricants—Patent #2,456,496—James G. Ford and Robert N. Wenzel, assignors to Westinghouse Electric Corp.

A lubricant composed of a mixture of liquid polymers of dialkyl silicones in which the alkyl groups each have at least two carbon atoms substantially free of the monoalkyl and trialkyl silicone derivatives, the lubricant being characterized by resistance to deterioration at high temperatures.

Soluble Oil Composition—Patent #2,456,587—Robert M. Koppenhoefer, assignor to Socony-Vacuum Oil Co., Inc.

An emulsifiable oil composition comprising: a major proportion of at least one oil suitable for fat liquoring which oil is selected from the group consisting of animal, mineral and vegetable oils; from about 6 to about 12 per cent by weight of a rosin acid; from about 6 to about 10 per cent by weight of a polyoxyalkylene derivative of a fatty acid ester of a hexitol anhydride, said fatty acid having at least six carbon atoms; from about 1 to about 4 per cent by weight of a fatty acid ester of a hexitol anhydride, said fatty acid having at least six carbon atoms; from about 3 to about 6 per cent by weight of a low molecular weight fatty acid of less than 5 carbon atoms; and from about 10 to about 16 per cent by weight of a compound having the general formula



where R_1 is selected from the group consisting of alkyl and alkenyl radicals containing from 10 to 18 carbon atoms and R_2 is an alkyl group containing 1 to 5 carbon atoms substituted with a radical selected from the group consisting of hydroxyl and amino radicals.

Grease Composition—Patent #2,456,642—Robert L. Merker.

A grease composition compatible with the addition of relatively small proportions of polymer thickeners, oxidadation, rust and corrosion inhibitors and extreme pressure additives comprising 5 to 30 parts by weight of a metallic soap and 95 to 70 parts of a fluid blend of between about 5 and about 95 parts by weight of a diester of a dicarboxylic acid and between about 95 and 5 parts by weight of a silicone.

Grease Composition—Patent #2,457,582—Paul R. McCarthy, assignor to Gulf Research & Development Co.

An improved grease composition comprising between about 55 and about 80 per cent by weight of a refined mineral oil having a viscosity between about 500 and about 2000 SUV at 100°F., between about 10 and about 20 per cent by weight of asphalt, and between about 10 and about 25 per cent by weight of a mixture of alkali-metal and zinc fatty acid soaps, the ratio of alkali-metal soap to zinc soap being between about 3:1 and about 1:1.

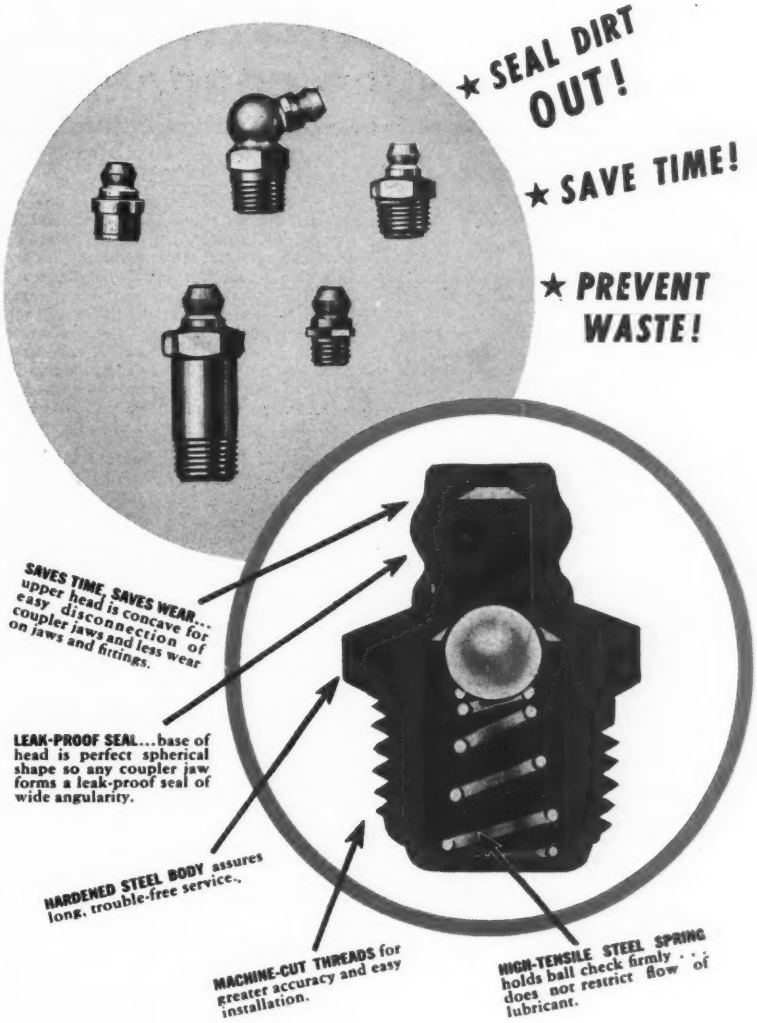
Grease Composition—Patent #2,457,586—John F. McGrogan, assignor to The Atlantic Refining Co.

A grease composition consisting essentially of mineral lubricating oil, calcium soaps of fatty acids in an amount sufficient to impart the desired consistency to the grease, and a small quantity of a lead salt of an aliphatic monocarboxylic acid containing not more than 8 carbon atoms sufficient to increase the dropping point of said grease to a temperature between 300°F. and 500°F.

Styrene-Oil Soluble Natural Resin-Drying Oil Interpolymer — Patent #2,457,768 — James A. Arvin and Wayne B. Gitchel, assignors to The Sherwin-Williams Co.

An interpolymer of styrene, an oil-soluble natural resin containing a free carboxylic acid group and having an acid value of at least 30 and 5% to 35% by weight of said interpolymer of a drying oil, interpolymerized at temperatures within the range of 300°F. to 550°F., the weight ratio of the resin to styrene being within the range of 1:1 to 9:1.

ARO Grease Fittings FOR EVERY NEED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★ PREVENT WASTE!
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LEAK-PROOF SEAL... base of head is perfect spherical shape so any coupler jaw forms a leak-proof seal of wide angularity.
HARDENED STEEL BODY assures long, trouble-free service.
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Specify ARO Grease Fittings for every lubrication point . . . they're precision-made . . . accurate . . . rugged . . . dependable. Can be serviced by all leading brands of hydraulic couplers. Complete range of types and sizes . . . Aro-built Quality. Write for Catalog 102. The Aro Equipment Corporation, Bryan, Ohio.

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"Grafo" Colloidal Graphite may be obtained in water, petroleum oil and castor oil, in concentrated, semi-concentrated and ready-for-use mediums.
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CONDUCTIVE COATINGS
EXTREME PRESSURES
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CURRENT LITERATURE

(*Continued from page* 30)

bearings with "unground" races lubricated with certain new greases outlasted the best quality precision bearings packed with conventional good ball bearing grease. These new greases contained lithium soaps and were developed especially for low temperature applications. A test machine is described and photograph shown. It was developed to oscillate the outer ring of an anti-friction bearing. Angle of oscillation and combination of radial and thrust loads could be varied to suit service conditions. The theory of lubricant failure is described. The type of failure discussed is called friction oxidation.

Vol. XII, No. 7, October, 1948

LUBRICATION A TOOL FOR PREVENTIVE MAINTENANCE
Cooper, H.—pp. 4, 8, 18-19

The importance of lubrication for preventive maintenance is stressed. The highly developed lubricating oils for modern precision mechanisms and specialized greases were keeping pace with machine design so that modern precision machines and lubricants became interdependent. With the cooperation of suppliers, plant operators should determine the lubricants which will serve most effectively under the operating conditions imposed; but selection of the proper lubricant does not assure good lubrication. It should be more fully realized that uninterrupted operation and maximum production depends on the correct lubricants, intelligently applied, scheduled and administered by understanding engineers.

ANSWERS TO YOUR QUESTIONS ABOUT POLYETHER SYNTHETIC LUBRICANTS
Griffith, S. C., Lewis, J. H., Kraus, R. A., Millett, W. H., Pritchard, C. E., Lykins, J. D., Sullivan, J. E., and Shoemaker, R. S.—p. 22

The September issue of the "Spokeman" carried an article entitled, "Industrial Uses of Some Polyether Synthetic Lubricants," by W. H. Millett. The discussion of the paper followed the presentation of same at the AISE Annual Convention, Pittsburgh, Pa., on September 24, 1947. This discussion and the author's comments are presented.

Vol. XII, No. 8, November, 1948

TESTING MACHINE FOR EVALUATION OF BALL AND ROLLER BEARING GREASE
Kaufman, G., Prendergast, W. A., and Strohecker, R. F.—pp. 4-5, 8, 10-11, 14, 18, 19, 23, 25-27, 30

This machine was first described by the senior author before the National Lubricating Grease Institute, Chicago, Illinois, October 1, 1938. In figures 1, 2 and 3, photographs of the apparatus before the installation of automatic controls are shown. Fifiure 5 shows operation of automatic controls. A tabulation presents and explains the descriptive terms of the rating system now used to indicate the general condition of grease and bearing at the end of a test.

Institute of Petroleum Review (London) Vol. II, No. 19, July, 1948

PETROLEUM IN PARLIAMENT. HYDROCARBON OIL DUTIES
Anon.—p. 210

The Chancellor of the Exchequer reported to the Parliament in a written reply on May 31, 1948, the amount of hydrocarbon oils retained for home consumption and the net amount received in respect of duty thereon during the year ended March 31, 1948. Data are tabulated.

Vol. II, No. 22, October, 1948

THE ENGINE PERFORMANCE OF LUBRICANTS
Williams, C. G.—pp. 306-316

Touching upon the general question of selecting laboratory engine test methods for assessing the performance of lubricants, the author discusses what happens to the oil and to the engine in service with particular reference to the formation of deposits, which usually have a controlling influence on lubricant performance. Two main causes of engine and oil deposits are discussed, namely: (1) Oxidation of the oil itself, and (2) Contamination resulting from the supply to the engine of air and fuel with their resulting products of combustion. Deposits in combustion chamber, ring groove deposits, piston lacquer, acids, and corrosion, sludge, fuel dilution, and ash content are taken up.

International Nickel Company Corrosion Reporter, Vol. III, No. 4, October, 1948

OBSERVATIONS ON FATS AND OILS. I
Anon.—pp. 1-9

The first four pages of this pamphlet are devoted to the works of the great French scientist, Hichel Eugene Chevreul (1786-1889) in the domain of fats and oils (saponification process, fatty acids, proximate analysis, production of soap, glycerine nad candles). The article covers fat-splitting in the human body, batch hydrolysis of fats at atmospheric pressure and higher, corrosion tests in fat-splitting and continuous high temperature—high pressure methods for fatty acid splitting.

Journal of the American Oil Chemists' Society, Vol. XXV, No. 8, August, 1948

A CONTINUOUS PROCESS FOR THE DEHYDRATION OF CASTOR OIL
Radlove, S. B., DeJong, Wm. and Falkenburg, L. B.—pp. 268-271

A process for dehydrating castor oil continuously has been presented. The method consists essentially of exposing the oil in a thin film under the vacuum to temperatures between 310° and 350° C. for short periods of time in the presence of a dilute sulfuric acid catalyst.

COMMERCIAL EXTRACTION OF VEGETABLE OILS BY MEANS OF TRICHLORETHYLENE
Duncan, I. J., pp. 277-278

Trichlorethylene, a powerful noninflammable fats and oil solvent and one of the principal chlorinated hydrocarbons used in metal degreasing, has been shown to be well suited for the extraction of vegetable oils from oil seeds. Data on extraction of soybean and cottonseed oils are presented.

PRESENT STATUS OF THE SYNTHETIC FATS PROBELM
Thomas, K. and Weitzel, G.—p. 299
(Suddeutschen Apotheker-Ztg, Vol. LXXXVII, 1947, pp. 255-6)

BEHAVIOR OF SYNTHETIC FATS FROM COAL AS FOOD
Thomas, K. and Weitzel, G.—p. 300
Deut. Med. Wochenschr, Vol. LXXI, 1946, pp. 18-21)

No Abstracts. Only Titles.

THE PHYSICAL AND CHEMICAL TREATMENT OF DRYING OILS
Elm, A. C., p. 302
(Paint, Oil, Chem. Rev., Vol. CXI, No. 13, 1948, pp. 11-19, 34-36)

The chemistry of dehydration, isomerization, blowing, and heat bodying in the production of improved drying oils is discussed with consideration of recent developments.

Vol. XXV, No. 10, October, 1948

ULTRAVIOLET LIGHT ABSORPTION OF STANDOILS
Pestemer, M. and Tschinkel, J.—p. 382
(Paint, Oil, Chem. Rev., Vol. CXI, No. 18, 1948, pp. 14-21)

This is translation from Fette und Seifen, Vol. L, 1943, pp. 153-158. Samples removed at two-hour intervals during the bodying of refined linseed oil at 285°C., 5-10 millimeters were examined for viscosity. Iodine number, specific gravity, refractive index, and ultraviolet light absorption, were studied. The re-

action consisting at first largely of intramolecular polymerization followed by intramolecular polymerization, interesterification, and a correspondingly large increase in viscosity, was investigated.

THE THEORY AND PRACTICE OF FORMATION OF STAND OILS
Vian, A. and Yzu, L.—pp. 382-383
(Ion, Vol. VII, 1947, pp. 749-62)

Samples of linseed oil removed hourly during polymerization under carbon dioxide at 290°C. and samples removed during the silent electric discharge polymerization of the same oil under carbon dioxide at 25-40°C., 5-millimeter pressure were examined for viscosity, refractive index, acid number, extinction coefficient, surface tension, and saponification number.

Journal of the Institute of Petroleum, Vol. XXXIV, No. 295, July, 1948

MECHANISM OF ACTION OF ANTI-CORROSIVE ADDITIVES
Krein, S. E. and Tarmanyan, G. S.,—p. 204A
(Neft. Khoz, No. 11, 1947, pp. 45-50)

Acid value cannot be taken as a guide to the corrosive action of oils on copper-lead alloy. Tests show that oleic and palmitic acids are 50-100% more aggressive than naphthenic acids of equal acid value. Oxidation tests of oil containing added naphthenic acid show that, in absence of anti-corrosive additive, attack on copper-lead is roughly proportional to acidity developed. Effect of additive is not to inhibit oxidation of oil, but to form protective layer on metal, such layer being continually renewed. Variations of additive effect with type of base oil are due to tendency for polar compounds present in the oil also to form a film on the metal surface.

MECHANICAL PROPERTIES OF GREASES
Vinogradov, G. V., Pavlov, V. P. and Klimov, K. I.—pp. 204A-205A
(Neft. Khoz, No. 12, 1947, pp. 47-50; 1944, No. 1, pp. 52-59)

Tests were carried out on a grease made from a Dossori distillate and containing 14.2% of the calcium soaps of cotton-seed oil acids and 2% water. The changes in grease deformation in a cylindrical viscometer were recorded photographically. Mechanical properties of these greases were investigated.

LOW TEMPERATURE PROPERTIES OF OILS CONTAINING VISCOUS ADDITIVES
Pushtov, N. G.—p. 205A
(Neft. Khoz, No. 3, 1948, pp. 49-56)

Tests were made using polyisobutylene and Voltol (up to 10%). Blends were prepared with distillate and residual oils and viscosities of blends were determined down to—40°C., also pour points and temperature, at which the fluidity was lost under a head equivalent to 25 centimeters water. Storage tests (14 months) showed no signs of additive separation in any of the blends.

TENDENCY OF TRANSFORMER AND TURBINE OILS TO FORM LOW MOLECULAR WEIGHT ACIDS IN THE INITIAL STAGES OF OXIDATION
Ivanov, K. I., Kleshch, N. V. and Zhakhovskaya, T. P.—p. 205A
(Neft. Khoz, No. 2, 1947, pp. 50-58)

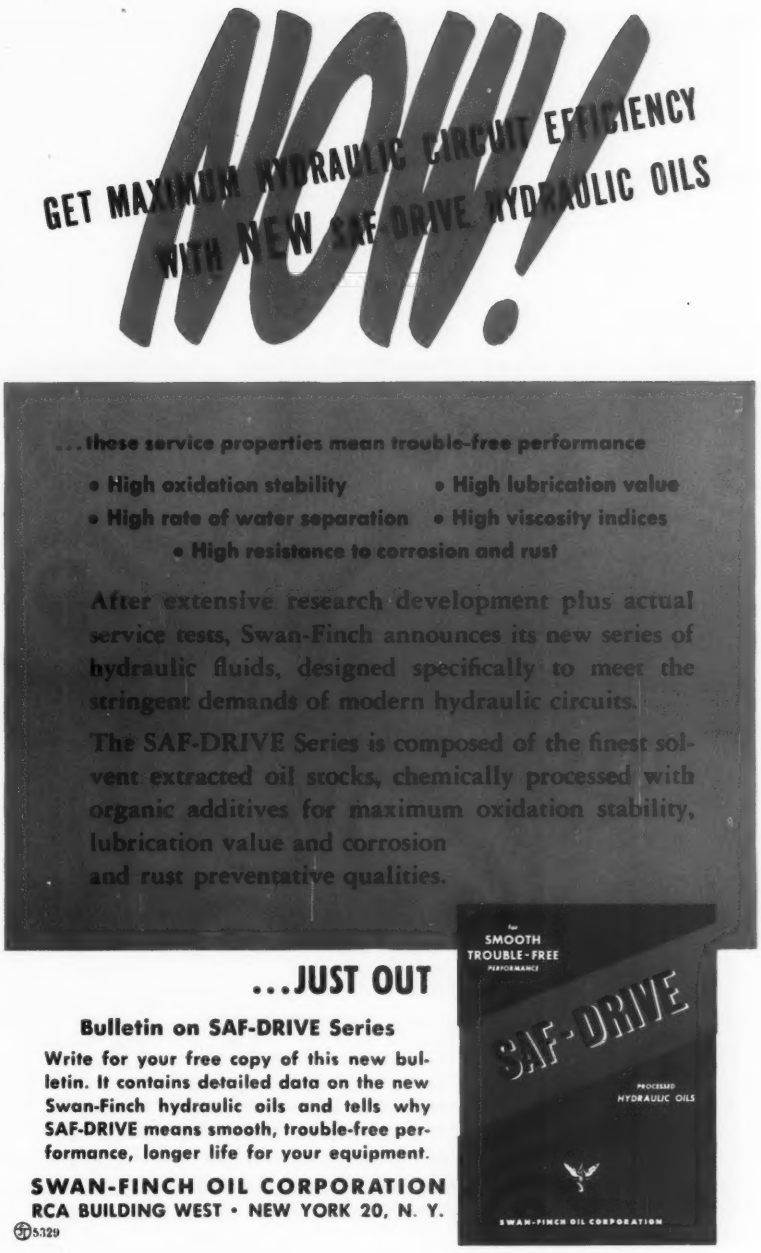
Numerous oils, produced from Russian crudes by acid treatment, were tested by the standard U.S.S.R. aging test designed to show early formation of low-molecular-weight acids. Low-molecular-weight acid formation is mainly due to resins, which can be removed by additional acid or, sometimes by clay. After-treatment and lead to more severe deterioration on oxidation, due to removal of natural inhibitors.

VISCOSITY OF LUBRICATING OILS AT HIGH RATES OF SHEAR
Blok, H.—p. 238A
(Ingenieur, Vol. XXI, May 21, 1948, Mk., pp. 58-63)

From a review of the experimental results available, the viscosity drops, claimed to be due to high rates of shear, can be attributed to thermal effects. For oils containing polymerized additives a real viscosity drop has been detected. It is suggested that a rotational viscometer of the Couette type with controlled heat fluxes be used in future experiments, as the thermal effects can be readily corrected for with this instrument.

LUBRICANT SYNTHESIS
Dupas, M. R.—p. 265-A
(Bull. Assoc. franc. Tech. Petrol., Vol. LXIX, 1948, pp. 1-16)

After a brief review of the chief methods for lubricating oil synthesis, a description (with flow sheet) is given of the process used at the Standard-Kuhlmann plant at Estaque. Lubricating oil is produced by a Friedel-Craft condensation of benzene with dichlorethane and a Fischer-Tropsch gas oil (180-320°C.) chlorinated to a chlorine content of 22-24%. Production is effected continuously in three steel vessels in the first of which (at 80°C.) benzene, dichlorethane, and aluminum powder are mixed. The chlorinated gas oil is added in the second stage (at 100°C.), and the reaction is concluded in the third vessel (at 120°C.).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SHELL INDUSTRIAL LUBRICANTS SHELL

W. R. MOORE DISCUSSION OF ROEHNER & CARMICHAEL PAPER

(*Continued from page* 18)

Much of the published work to date attempts to evaluate lubricants on the basis of certain limited, obvious variables—for example, rpm versus temp. rise or power consumption against rate of feed. Because of the great number of variables it seems possible that the field of lubrication should be a fertile one for the use of statistical methods, particularly in the case of correlation of variables.

Generally the users of lubricating products are looking for better and better materials as regards aging stability, film strength and so forth. To hear of cases where a product is too good is therefore the occasion of some surprise. One case comes to mind in which distortion was occurring in a broaching operation because the lubricant had such high film strength that the cutting edge of the broach became inoperative. Yesterday afternoon in a paper on the lubrication of mining machinery, it was pointed out that extreme pressure type lubricants could not be used in a hydraulic gear compartment because the bands could not grip the planetaries in a proper manner. In the case of some of our own products, it was found during the war period that highly refined, additive type oils gave trouble in the lubrication of certain lead babbitt sleeve bearings. The bearings deteriorated rapidly in some cases with the formation of lead sludges and granular metalic particles. Certain ordinary, run of mine lubricating oils were found to give satisfactory service.

In conclusion, it seems to me, that functional testing will become more and more acceptable as users of lubricants become better acquainted with the types of information available from the various classes of testers, particularly when this is correlated more critically with conditions peculiar to individual applications.

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Acro Metal Stamping Co.	48
Alemite	42
Aro Equipment Corp., The	43
Bijur Lubricating Corporation	4
Burns Laboratories, Inc.	41
Cincinnati Milling Machine Co.	8
Cuno Engineering Corp.,	5
Dow Corning Corp.	39
Farval Corporation, The	Inside Back Cover
Gits Bros. Mfg. Company	47
Grafo Colloids Corporation	44
Hodson Corporation, The	Back Cover
Honan-Crane Corp.	40-41
Houghton, E. F. & Co.	7
Lincoln Engineering Co.	6
Madison-Kipp Corporation	3
Manzel, Inc.	39
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Shell Oil Company, Inc.	46
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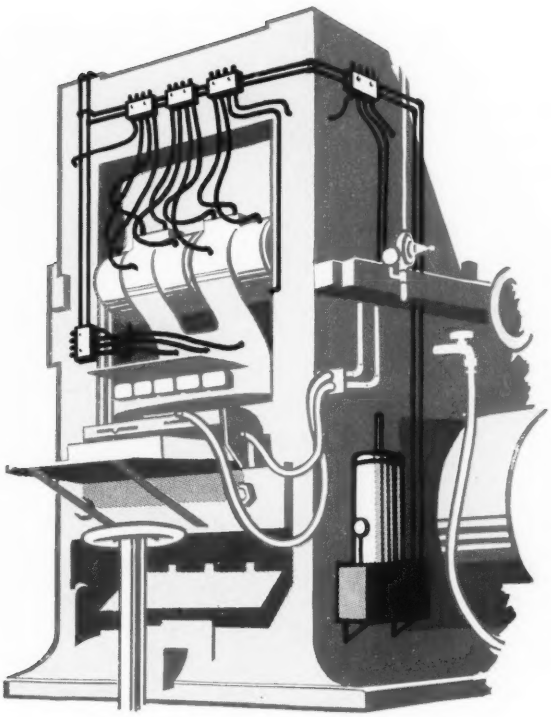

RAPID wear of bearings was forcing a brick company to overhaul its brick presses every few months. It was costing about $1,750 to replace each press front, including upper and lower toggles and slides. In some plants where pressures were extreme and highly abrasive brick dust was encountered, fronts had to be replaced every 90 days.

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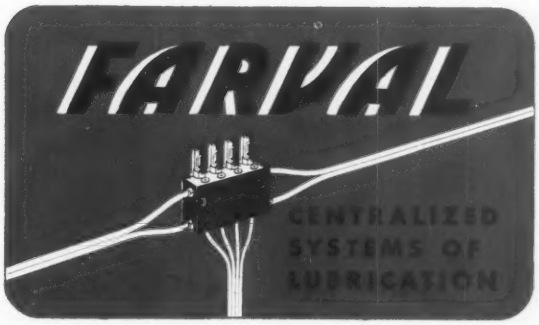

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